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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE
INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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"Working Hours" and the Foundry.

In August, 1919, a joint committee of the Engineering and National Employers' Federation, the Shipbuilding Employers' Federation and Unions' Negotiating Committee was formed to investigate the economic relation of production to hours of work. It consisted of equal representation of both employer and employé. The report has just been published, and contains much of interest for foundrymen apart from any political issues with which we do not deal in these columns, confining ourselves to drawing the attention of our readers to matters concerning production. This, we take it, is within our province. Before dealing with this aspect, however, it is worth while noting that no foundryman could read this report without realising the immense importance of his work. To give some random quotations: "The restriction of output in the foundry prevented the employment of more people in the machine shops." "The shortage of castings was preventing the employment of more workpeople in other departments." "It was stated that the moulders' strike had caused greater injury to the industry than any other strike which had ever occurred, and as a result of the refusal to work overtime after the strike was over, they had lost a great number of orders which otherwise would have come into the works, and the present (August, 1921) unemployment in the engineering industry would have been largely avoided or in any event postponed for several months." Now all this points out in the clearest possible manner that foundry work is a key industry, and all connected with it have the undoubted right of assuming that their social and industrial status is in every way equal to that of allied trades. It is certainly worthy of something better than the conditions existing in Firm No. 2 reported on by Committee, about which they say, "The foundry is a converted dwelling house. The character of the work is against moulding machines." It is existence of this type of foundry that lowers the status of the industry.

The Report includes a section devoted to visits to works in Belgium, Germany and Holland in April and May of last year, and in it are some interesting references to foundry work. For instance, at the Ateliers de Constructions Electriques de Charleroi concern, the Committee report that, "In the foundry 95 men and boys are employed in moulding, piece work being the rule both for hand moulding and machine moulding. Their present output is 210 tons per ton as compared with 165 tons per month with 75 employés before the war. Pneumatic hammers are used for fettling, and it was stated the men preferred them." Leaving the Continental report for a moment, it is interesting to compare the above with the written reply received from Firm No. 14 in answer to a questionaire: "The foundry is old and the ventilation not very good, but the crane equipment is efficient and pneumatic and hydraulic machines had been installed but abandoned in favour of hand-operated machines as being more satisfactory. Pneumatic appliances had been abandoned in the fettling shop on account of the very high cost of maintenance." We refrain from the obvious comment!

To return to the Continental section of the Report. Dealing with the De Fries concern of Düsseldorf, Germany, the Committee, reporting on the efficiency of production, state: "For the foundry the average figures for the years 1910-14 were 35 tons per man per year. Output in 1919 had fallen to 22 tons per year, and in 1920 to 21 tons per year per man. The low output of 1920, however, was apparently attributed to the fact that trade was slack with them at the time. It was noticed that men were using pneumatic rammers in the foundry, and that satisfactory results were being obtained from them."

The only mention of the foundry during the Dutch visit was at the works of the Werf Conrad firm at Haarlem, near Amsterdam, where the Committee, reporting on efficiency, state: "They (the Dutch) have no difficulty whatever with regard to demarcation, *e.g.*, the floating dock being urgently required for a ship that was coming in, the whole of the foundrymen turned out to paint the bottom of the ship in dock, in order to get her out in time." This should enhance the reputation of foundrymen as handy men!

No attempt has been made by the Committee to arrive at any general conclusions, but some are so obvious that it may be worth while if we draw attention to them in a non-committal way. As

already set out, a perusal of the Report cannot help but impress one of the importance of foundry work to shipbuilding and engineering. The second feature is the necessity for the closest co-operation of all concerned. Another deduction is that industry, in the largest sense of the word, is more prosperous where individual piece work can be arranged, and after that some of the many schemes of bonus on output. Payment on a time basis does not appear to pay the individual or the master. Another factor which impresses the reader is the prevalence of slackness at the beginning and end of shifts. To give two quotations from the Report on this subject: "The Committee when going through the yard noticed from 11.35 a.m. till noon, when the works stopped for the dinner hour, considerable numbers of men had ceased work and were proceeding to the main exits, large numbers being gathered at the time office when the buzzer blew." "There were many complaints as to the slackness of the men in both starting and stopping work, and the Committee saw for themselves plentiful evidence of this disgraceful state of affairs in the portion of the works they happened to be in, just before 12 noon."

A pleasing feature is the progress which had been made in recent years in welfare work.

The influence of trade union restrictions on overtime, and its bearing on the loss of orders and consequent unemployment, also forms an important section. Apart from its political aspect, the Report is well worth the closest study by all foundrymen genuinely interested in the general welfare of the industry at large. If it is to withstand the ravages of foreign competition the employers on the one side must provide the very best equipment and the employés on the other side must learn to use them intelligently. In other words, the converted-house type of foundry must disappear, together with any antipathy to labour-aiding devices.

Notes from Canada.

Messrs. J. D. Shipton and A. W. Noble, of Vancouver, are reported to be negotiating with the municipality of Chilliwack for a free site on which to establish an iron and steel plant. Mr. Noble states that control has been obtained of ten iron-ore claims, and that there is plenty of high-grade coal in the district.

The British Empire Steel Corporation's mines on Belle Isle, Newfoundland, are working night and day on the shipping of Wabana iron ore direct to German ports. The steamers, "Henrick Ibsen," 7,100 tons; "Greldon," 7,500 tons; and "Cymric," 6,200 tons, all sailed recently for Bremerhaven, and several other ships were scheduled to clear at a later date.

The large plant of the International Nickel Company, Limited, at Copper Cliff, Ontario, recommenced operations on September 1 last, after having been closed down for 18 months. The Company is operating at one-third of its capacity, and it is proposed to work with 650 hands. Regular consignments of matte will be made to the refinery at Port Colborne, Ontario, where all of the refining is to be done hereafter, the plant at Bayonne, N.J., having been scrapped. The refined nickel will be despatched to the new rolling mills at Huntingdon, Virginia, where it will be rolled into malleable metal and marketed mostly in the United States.

The local press at Sault Ste. Marie, Ontario, in commenting upon the large loss sustained by the Algoma Steel Corporation on last year's operations, hints at some important changes in connection with that Company. Rail-making has not proved to be a profitable business in the past, and it seems likely that, by reason of reduced demand and more competition, it may be even less so in the future. There are now three trans-continental railway lines across the Dominion, two more lines are well under way to Hudson's Bay, and there is the prospect of constructing a deeper waterway from the Atlantic through the St. Lawrence and Great Lakes to the middle of the continent. These systems of transport will be more than ample to handle the heavy freight likely to be available in Canada for many years to come. The demand for rails in future will therefore be limited to repairs and to short feeding branch lines, calling for a steady output, though one not reaching to the huge demand occasioned in the past by the construction of long trunk roads. The Corporation's structural steel plant, manufacturing a material for which there is an ever-growing demand, with little competition from other Canadian concerns, will therefore in all probability be the main stand-by, and other lines of manufacture will be added.

Testing Malleable Iron.*

Section by M. L. Piedbœuf.

At the Liège Congress in 1921, M. Remy suggested that research should be conducted on the subject of testing malleable iron. The author has established the following system at the Fonderies et Ateliers Simonon, at Herstal, which has been found to be successful for the daily control of manufacture.

Chemical Analysis.

The pigs used possess fairly regular composition, so much so that it is now possible to control satisfactorily the contents which are subject to variation. Grey pigs contain about 3.5 per cent. carbon and 1 per cent. silicon. Phosphorus does not exceed 0.15, and sulphur 0.05. It has been found, however, that the silicon content is very variable, so much so, that this element must be analysed from samples taken from each wagon received. It is necessary that the silicon content in the charge must always be maintained within certain limits if trouble is to be avoided.

White iron contains up to 0.15 per cent. sulphur, and it is obviously necessary to institute a control. The charge is so arranged that the quantity of white iron used is reduced to a minimum. It is equally useful to control periodically the silicon and sulphur content in the hard castings. This is particularly necessary in foundries which are engaged principally upon the manufacture of light castings.

Because of the considerable proportion of runner scrap used there is introduced a progressive increase in the sulphur content. When this has a tendency to become high, the runners and risers are subjected to a special desulphurising treatment in order to reduce them to a normal proportion.

Mechanical Testing.

After having tried various types of tensile and bending test-pieces, the American bending type having a thickness of from 12.7 to 1.5 mm. has been finally adopted. These bending tests have given good results from the point of view of daily control, two being taken from each cast. The first one is useful for checking the condition of the hard iron, and the second for determining the strength as shown by bending after decarbonisation. After bending the tests undergo a microscopic control so as to determine the constitution of the iron from this aspect.

The work of the annealing furnaces is controlled by registering pyrometers.

The difficulties associated with moulding test-pieces and the carrying out of the tests, also the very irregular results obtained, do not appeal to foundrymen. The system adopted in the author's foundry appears to be one which could be adopted by the majority of foundries manufacturing malleable iron.

It is interesting to note that the Germans have sent round the following questionnaire dealing with the conditions for testing and buying for the malleable trade:—

(1) What chemical composition do you consider best? (2) What types of physical test, particularly tensile tests, do you favour? (3) What type of test-piece should be adopted for tensile testing? (4) What do you consider to be the minimum values for the tensile strength and elongation? (5) Should malleable iron be divided into different quality categories, their being based upon the tensile strength and the elongation? (6) Are tensile tests necessary for ordinary malleable or is it necessary to take test-pieces from a definite number of castings? (7) Is it necessary to try to establish certain typical test-pieces, in order to facilitate the obtaining of comparative tests of the density of the metal? (8) What specific gravity do you consider normal? (9) What do you consider the normal contraction to be? (10) What special conditions ought to be laid down for malleables to be utilised for magneto and dynamo work?

The author proposes that the following should be added:—(*a*) How can good test-pieces be cast under foundry conditions? (*b*) What allowances can be normally tolerated between the dimensions of the castings and those given on the blue prints? (*c*) Should scrap due to badly-designed patterns be charged to the foundry or the customer?

* Abstract of a paper read before the A.T.F.

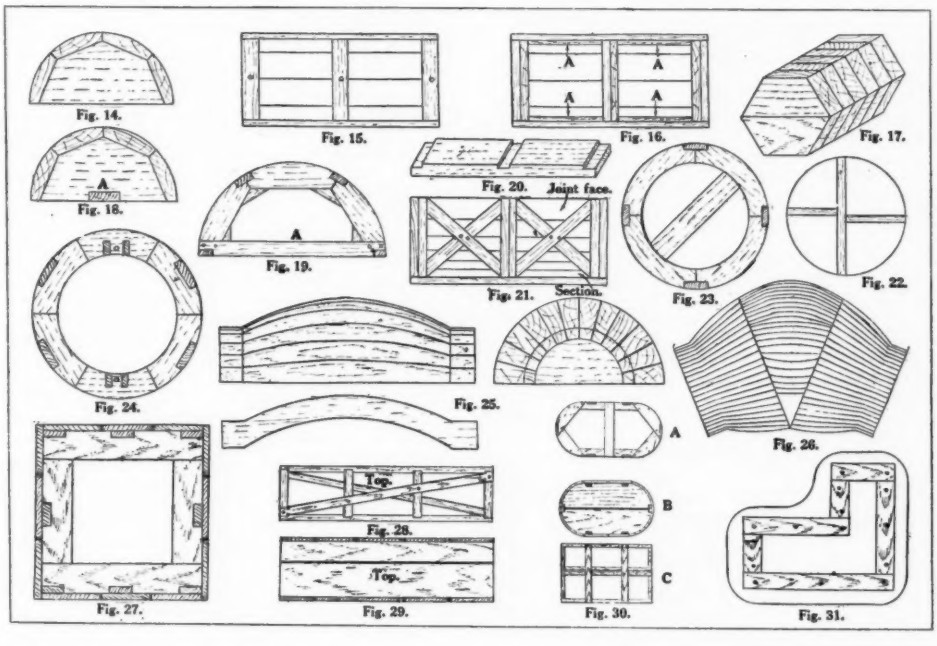
An Apprenticeship Course in Foundry Practice.—XIII.

By Ben Shaw and James Edgar.

METHODS USED IN PATTERN CONSTRUCTION.

PART 2.

Barrel Construction.—Boxed-up construction, in many cases, consists of lagging fastened to grounds, and patternmakers usually identify lagged work as barrel making. When a comparatively long cylindrical for of over 6 in. dia. has to be made it ought to be built with lagging on the grounds. Built thus, it will be much more durable than if made from solid timber, and incidentally it would be much lighter. There are many barrel constructions, and much depends not only on the size of the pattern but on whether it will be moulded on end or not. Barrels for end moulding are always made in one piece unless when of very large diameter, then it may be convenient to box up a square centre and complete the diameter with segments, but, if for horizontal moulding, they should be in two halves dowelled together.



Small Barrels.

Figs. 14 and 15 illustrate a method of construction which is very suitable for sizes up to 10 or 12 in. dia. which will not be required for many castings. Fig. 14 is an end view and Fig. 16 a join view. The grounds should be 1¾ or 2 in. thick, and not more than 18 in. apart. There cannot be too many grounds, and if the number is limited so that they are placed too far apart in a long barrel the pattern will not long withstand the rather rough usage of the foundry. The shape of the grounds is determined by the size of the barrel, as the staves should not be wider than 4½ in., thus they may be hexagonal, octagonal, etc. Some patternmakers nail barrels, but it is much better to screw them, especially if for a standard pattern. For a standard pattern, however, a better-quality barrel would be made. If the timber used for a half-barrel similar to Fig. 15 is wet, or if the pattern is carelessly left in the damp sand, it will become either less or more than a half-circle. This danger can be obviated by crossing the grounds as shown in Fig. 16, and it is good practice to nail strips A between the grounds, thus preventing any possibility of them being knocked in and also providing rapping surfaces for the moulder. With regard to stave thickness, this should not be less than 1 in. on small barrels; it is customary to use 1¼-in. timber. In some shops staves are planed concave and convex on the thickness-planing machine, and it is not customary to turn barrels. A turned barrel, however, is in all cases much superior to a planed barrel.

In commencing to make a barrel, the constructional view of the end should be set down in the first place. Very little should be left for turning at the middle of the staves. The grounds should not be drawn and sawn separately, but those for each half screwed together (see Fig. 17), both faces of each ground and one edge have been planed. The two sets should then be dowelled together, centre lines drawn on the faces and squared on the ends. The shape can then be drawn on each end, whether they are for canted or circular grounds, and, after being bandsawn, they may be either planed or sand-papered on a disc machine. With regard to the staves, very little hand-planing should be necessary if care is taken in setting the planing machine fence at the correct angle. The staves should not be left more than 1/16 in. larger than the finished size. To build the barrel, a thick building-board slightly narrower than the width of the grounds should be used and a centre line gauged on it. The position of the grounds may then be marked after which they can be screwed to the board. In building any size of staved barrel it is always advisable to start with the centre stave. When the joint is reached a 1/16 in. may be left over for final flushing. Either one or two screws should be used in the width of each stave into each ground. In boring the screw holes, centre bit holes, large enough to receive the heads of the screws to be used, should first be bored, and their depth should be sufficient to enable the screws being countersunk at least ¼ in. below the finished diameter of the barrels. When the staves have been screwed on the grounds these holes are plugged, and for this purpose short lengths of wood having the grain running with the staves may be planed up. These plugs should be tight-fitting and driven in after being dipped in hot glue. A practice to be recommended when building barrels with grounds about 12 in. wide is to set in a checked stay as shown at A, Fig. 18, before fitting on the staves. This serves the same purpose as strips nailed between the grounds in that it prevents them from being accidentally knocked in.

Large Barrels.

While the construction described above is satisfactory for small barrels, it is really suitable for large barrels that have to be made in halves, although in some patternshops the grounds for the largest size of barrels are made of two thicknesses of timber crossed and without any additional staying. A better form of construction is that shown at Fig. 19. This consists of two thicknesses of 1- or 1¼-in. timber crossed, although the rail, A, need only be half the thickness of the grounds. After these grounds have been built they should all be screwed together and the slots sawn out at the band-saw. Very little finishing with plane and chisel should be necessary. In building a barrel of this description the stays should first be screwed into position. The stays, similar to Fig. 20, it may be mentioned, should be about 4 in. wide and 2 in. thick, with a check or shoulder at least ½ in. deep. As an alternative to checked stays, some patternmakers adopt the method of using diagonal stays (Fig. 21), but it does not result in as strong a construction and it is not a much quicker method. The number of stays used, of course, depends upon the size of the barrel. While four stays as shown at Fig. 19 are satisfactory for barrels up to about 2 ft. 6 in., more are necessary for larger barrels.

End-Moulded Barrels.

Barrels for end moulding must be tapered, the amount of taper depending to some extent on the requirements of the foundry, but we shall not concern ourselves here with taper, but confine our attention to actual constructional details. For small sizes—up to 12 in. in diameter—the grounds should be of crossed timber as for half-barrels, but instead of stays, frames or simple boards about 1¾ in. or 2 in. thick are used to support the grounds (Fig. 22). An important feature of this construction is that, if a plate is set into the bottom ground and a rod lowered through the pattern, the frames which clear the centre serve as a guide for the rod. Building such a barrel does not cause much difficulty, if care is taken, before the lagging is screwed on, to ensure that the framework is not twisted. This can most easily be done by placing the construction with a ground resting on a level board and testing with a set square.

With complete barrels—barrels that are not in halves—that are of larger size than the foregoing, rings must be built segmentally either 4 or 6 segments to the diameter, and stays and cross rails screwed on the under side of the frames or built into the rings for the lifting rod, as shown at Fig. 23. For the very largest type of barrels two lifting rods may be necessary, and the frames must be strengthened on either side of the rods. This is clearly shown at Fig. 24. This construction is only adopted for very long barrels of large diameter such as are used for propeller brackets. For these large barrels the lagging should be proportionately heavy, in some cases being 2 in. thick to withstand the pressure of sand during the time of ramming.

So far we have only dealt with parallel barrels, but barrels have frequently to be made for large valves. A very common design of valve is that known as the through valve. For small and medium sizes these may be made solid, but when large it is necessary to build them. The grounds are crossed in the usual way, but the lagging must be sawn to allow at least 3/16 in. for turning and, in order to economise timber as well as to reduce weight, they should not be more than 2 in. wide. The whole construction is made clear in Fig. 25. The lagging may be sawn or machine-planed to the correct taper. When building such a pattern only every third or fourth stave should be screwed into the grounds, but the staves should be screwed to each other. This is a very strong constructional method, and is suitable for many designs of valves. It may appear costly, but if the proper use is made of the various machines it need not be so. Fig. 26 shows a valve that has been lagged up in this way; of course in this case a joint frame would have to be made and on this the pattern built. The middle portion would be the most difficult, as all the staves are of different lengths.

The methods just described do not cover the subject, but we believe, from an extended experience, that they are the best methods. In some shops, even when building large barrels for cylinders and condensers, it is the practice to substitute the shouldered stay by distance frames. The mode of procedure when this is done is to make the grounds first and carefully draw centre lines on them, after which one ground is temporarily screwed to a level floor or to "skids"—these being two or three runners about 2 in. thick which are fastened to the floor and levelled. The set of frames are now placed on the bottom ground and the second ground placed on top of them. Either a set square can now be used to test the work, or a straight-edge may be placed to the centre lines of the ground and a plumb dropped to the line on the floor. The operation is repeated as each ground is placed on the distance frames and secured after the correct position is located. A very sound job is obtained in this way, but it is not recommended for other than large cylinder or condenser barrels, when the whole pattern work may be built on the barrel from lines drawn on the level floor, and thus a slight twist of the barrel would cause trouble when assembling the various parts.

With large barrels the principle of having open joints to localise any change of form due to the timber either absorbing or giving off moisture is frequently resorted to, particularly if it is to be used for many castings over a long period. Even though the barrels may be painted, the moisture has access to the inside, and open joints are an advantage for work of a standardised character. An open joint may be left between each stave, but it is better to make alternative joints or every third joint open about ⅛ in. when it is desirable to maintain as true a shape as possible over a long period.

Boxing Up.

Many patterns are spoilt because of the faulty construction of the main body. Some patternmakers think that if thick timber is used strength is assured, whereas some of the lightest patterns are the strongest. We have seen cylinder patterns made of teak and almost solid, but such work does not reflect great credit on the shop which turns it out. In the South of England the tendency generally is for too-thick timber to be used for many purposes, while on the Clyde they go to the opposite extreme and build too flimsy work. Correct jointing and construction are exceptionally important, and a heavy pattern that is badly constructed is weak in proportion to its weight.

We may, for the purpose of this article, define boxing up as the construction of square, rectangular, and irregular-shaped bodies which cannot very well be made in any other way or because they lend themselves to the method more than to the staving or segmental methods. The young patternmaker is often in a dilemma, when making a shallow pattern, as to whether it ought to be made from the solid or boxed up. There can be no hard-and-fast rule. A boxed-up pattern is always the stronger, although it is unnecessary to box up a small square pattern 3 in. thick.

In a previous article concerning the jointing of timber, we described the best method of making small boxes, but it was only suitable for work up to 12 or 14 in. square. Above this size it is necessary to make frames. The method of making a framed square construction does not differ very materially from the method of building a barrel. Fig. 27 shows such a box. The frames should be made of rails about 4½ in. wide and 1¾ or 2 in. thick, but the lagging need not be more than ⅞ or 1 in. The stays are shouldered on to the frames. If accuracy is observed when planing the frames it should only be necessary to clean the outside afterwards. There ought, however, to be taper in the depth, and it is much easier to plane this, if it is not over ⅛ in., than make the frames of different sizes. If it is intended to use a centre rod for lifting it out of the mould special battens must be screwed on the underside of the frames. If the frames are much over 18 in. square, of course centre rails are necessary. Lifting straps are frequently used instead of rods for square and rectangular patterns, and these should be fitted where the lagging is strengthened by

stays. The lagging or covering boards should, for all boxed-up patterns, be screwed on so that the grain will be vertical in the mould. If this is not done the side of the mould may be badly damaged when drawing out the pattern. For building very long rectangular box-shapes, various methods are adopted, but whichever method is adopted, parallel straight-edges should be in almost continuous use to prevent the possibility of a twisted construction. Frames are necessary for every 18 in. of length, and in some pattern-shops longitudinal stays are thought sufficient. It is better, however, in addition to side stays for supporting the covering boards, to fit diagonal pieces as shown at Fig. 28. It is nearly impossible for work to get out of square when this is done. It will be noticed (Fig. 29) that both top and bottom boards run lengthwise of the pattern.

The forms we have described are regular, but when the general principles governing good boxing up are grasped, there is no difficulty in applying them to any shape.

When it is necessary or advisable to fill in the frames this is easily done by sawing checks from the rails before they are screwed together in order that a panel may rest on them.

Before leaving the subject of boxing up, it may be well to consider one or two other fairly common shapes, as, for instance, that shown at Fig. 30 B. The method of construction does not, as will be evident from the sketches, differ much from an ordinary rectangular block. When it is not a very large pattern solid plates are made. In really high-class work these plates should be crossed as described in making the grounds for barrels and, if large, frames should be made (A Fig. 30). It may be necessary, when making such a pattern, to joint it in the centre because of branches or to facilitate coring, and it is much more satisfactory to build the pattern in one length and saw it in two afterwards. All that is necessary is to keep the centre plates, as shown at C Fig. 30, about ½ in. apart with distance pieces to allow for a saw cut. It increases the effectiveness of the method if the centre plates are dowelled together before the stays are screwed on.

Many large branches have to be boxed up, and sometimes these tax the ingenuity of the pattern-maker, and he may have to adopt a partly-solid and partly-boxed construction. It is the practice in some shops to make plates to the finished size of the work and then build between check pieces, which are frames keeping the plates the correct distance apart and are screwed to the plates, as shown at Fig. 31, but it is not as good a construction as making grounds and covering them.

German Company News.

The financial results of various companies for 1921-22 are given below in marks, and the corresponding figures for the preceding year are shown in parentheses :—

Van der Zypen & Wissen United Steel Works Company, Cologne-Deutz. Gross profits, 40,102,000 (19,948,000); written off for depreciation, 3,065,000 (3,758,000); net profits, 37,036,000 (16,190,000); dividend at rate of 100 per cent. (30).

Annen Cast Steel Works Company, Annen. Depreciation, 1,140,000 (710,000); net profits, 1,240,000 (3,130,000); dividend, 15 per cent. (15).

Rombach Ironworks Company, Coblence.—Dividend at the rate of 25 per cent. (16).

Gaggenau Ironworks Company. — Depreciation, 3,349,000 (784,000); net profits, 7,874,000 (2,152,000); dividend, 25 per cent. (12).

Geisweid Ironworks Company.—Dividend at the rate of 50 per cent. (32).

Allgemeine Elektrizitäts Gesellschaft proposes to pay a dividend of 25 per cent. and to increase its capital by 300,000,000 marks.

Harkortsche Bergwerke und Chemische Fabriken, of Gotha, proposes to pay a dividend of 50 per cent. and a bonus of 100 per cent.

LICENCES UNDER the Non-Ferrous Metal Industry Act, 1918, have been granted to F. Griffin, trading as F. Griffin & Company, 34, Great St. Helens, London, E.C.3, and T. S. Sutton, trading as Thomas S. Sutton & Sons, Gas Works Road, Neath.

The Ceramic Society.

Autumn Meeting at Birmingham.

The Autumn Meeting of the Refractory Materials Section of the Ceramic Society was held at the Birmingham Chamber of Commerce on October 3 and 4, Lt.-Col. C. W. Thomas presiding. Abstracts from two of the Papers are given below.

Some New Forms of Kilns.

In his Paper on this subject, which was illustrated by lantern slides, SIR ARTHUR DUCKHAM described, in the first place, a continuous kiln of 16 chambers, each 19 ft. 1½ in. wide, 16 ft. 9 in. long, and 6 ft. high to the springing of the arch. They were arranged in two rows, side by side, and each chamber had four fire-holes and bags, the firing being semi-gaseous. The kiln was used for burning Stourbridge firebricks made of local clay, with clay grog and silica. Each chamber contained 60 tons of material, and 14 or 15 chambers were burned per month, the fuel consumption amounting to 20 to 25 tons of coal per 100 tons of material. During the burning, two chambers ahead of the firing chamber and two behind were worked at the same time. It was found necessary to substitute artificial draft for natural draft to ensure satisfactory results under all conditions, and this also increased the output.

A kiln known as the W.D. Central Bag Kiln has the important advantages that uniform heating is obtained; the centrally-situated bag can be made of different material from that of the kiln itself; proper combustion of the heating gases is assured, and the brickwork of the kiln proper is never subject to the direct action of the heating gases during combustion. Satisfactory results have been obtained from a single chamber of this type, with an outside gas producer burning coal.

In order to overcome the disadvantages of tunnel kilns, two modified kilns of that type were designed. An open-tunnel kiln had cross walls on each truck carrying the material, the cross walls registering with offsets on the kiln walls, so that the gases were forced to take a zig-zag path. In this way the length of the kiln can be reduced from 300 ft. to 130 ft. Other special arrangements help in securing uniform heating and proper cooling. An annular tunnel kiln was designed for the slow and uniform firing of large glazed goods at about 1,100 deg. C., the heating gases being muffled. At the unloading and loading point the continuity of the tunnel is interrupted, but the annular firebrick tray carrying the material is continuous and unbroken. Producer gas is used for heating the kiln, combustion taking place in six separate horizontal flues situated one above another in the side walls of the tunnel. Mechanical draft is supplied by means of a fan and motor. The chief advantages of this kiln are convenience of working, elimination of trucks, uniform heating, and economy of fuel.

The Grading of Silica Bricks.

In this Paper MESSRS. P. B. ROBINSON and W. J. REES gave grade analyses of green bricks, and correlated them with the properties of the corresponding burned bricks. In general about 40 per cent. of the material was found to remain on a 30-mesh sieve, and about 40 per cent. passed through a sieve with 100 meshes to the inch. Grading curves indicated that it was impossible, with ordinary pan mill crushing, to get sufficient fine material to give a brick of appreciably less porosity than those at present made, as increased time of grinding only led to the production (in the various ganisters examined) of material of about 100 mesh size (0.2-0.3 mm.), and it was shown that for the production of a dense brick fine-ground material from a ball mill must be added.

The conclusions reached by the authors were that (*a*) a hard rock crushing into fragments of high angularity should be used, (*b*) the best sizes for the largest pieces in the brick are 6-7 mm., which impart strength at high and low temperatures alike, (c) at least 40 per cent. of fine-ground material passing 100 mesh must be present, and for a dense brick (*i.e.*, with less than about 27 per cent. porosity) addition of fine-ground material from a ball mill must be made, and (*d*) the bricks must be well burned.

Institution of British Foundrymen.

NEWCASTLE BRANCH.

The annual meeting was held on Saturday, September 30, 1922. The annual report having been adopted, the election of officers was proceeded with, Mr. H. J. Young being elected as President, Mr. S. W. Wise as Senior Vice-President, and Mr. J. W. Frier as Junior Vice-President of the Branch. The following were elected to the Council: Messrs. Frank Adam, Colin Gresty, T. McPherson, and E. Wood, and Messrs. M. B. Herbst, J. N. Simm, J. D. Carmichael, and J. W. Frier were again appointed as delegates to the General Council. The two reception officers chosen were Messrs. Elliott and S. E. Smith. Mr. H. A. J. Rang was unanimously re-elected as honorary secretary.

Mr. H. J. Young said the Newcastle Branch had lost a very valuable president, Mr. R. O. Patterson having retired according to rule. It was a great honour to Newcastle that Mr. Patterson had been elected as Junior Vice-President of the parent body. A hearty vote of thanks was then accorded to Mr. Patterson.

Mr. Patterson, in reply, said that he had enjoyed his year of office very much and had found it most interesting. He had been exceptionally well backed up by his officers.

Mr. Young then delivered the following address.

Presidential Address.

Ladies and Gentlemen,—Being your President fills me with both delight and dismay—delight that my profession should be so honoured, dismay lest I should make a mess of the job at a time when, above all times, science is most wanted, and most wanting, in the foundry practice of this country.

Science has been described as nothing but good sense and reason; on the other hand, you never met a fool but who thought himself well-stocked with these commodities. The privilege of making a fool of oneself is extended to chemists as well as to other men, but the folly of any particular chemist is no argument against science—though I have frequently heard it used as such by foundrymen.

You will remember the old saying that "Silence is golden." It is really a reporter's error, the correct word being "Science." How did Germany get the money to prepare for and to wage the most expensive war in history? Why is she still one of our most dangerous competitors? Her shipyards and dry docks are choked with work; her manufactures are pouring into this and other enemy countries.

Meanwhile our own men are unemployed by the hundreds of thousands. What does it all mean? I suggest that Germany does it by scientific thinking, scientific manufacture, scientific business methods and finance, scientific methods of education, and scientific defeat, if you like to call it so.

However that may be, this is no time for self-congratulation, and I make no apology for the fact that my address will consist of criticisms of our deficiencies rather than expiations of the undoubted progress made by this Institution.

A man's mind can be so unbalanced that he is unable to tell whether the sun is rising or setting, but the nature of the Britisher is often such that, even after having seen several sunsets, he still remains incapable of recognising the signs of one until darkness falls.

In foundry work especially have we to make a clean sweep of our old ways if we desire to make the sun rise and to prevent it setting. It is absolutely essential that every foundry, or every group of foundries, should have its own laboratory, and this must not be a paltry affair either in equipment or staff. It is essential that every foundry in the country belongs to the Cast Iron Research Association, and then those foundries with laboratories will be in a good position to make the best use of the device and research work of that association.

Ignorance in Foundries.

One would hardly expect a foundryman to be an unread and ignorant person, yet to-day there exist many who know less than nothing about the facts, the most elementary facts, concerning their metals, their sands, their furnaces, or about what the rest of the world is doing and thinking.

This state of things *must* cease if British foundrywork is to hold its own. Unfortunately, far from ceasing, it looks, to judge from the type of boy now coming into the foundry, as if it will get far worse.

Certificated Foundrymen.

I suggest that there would be a great and steady improvement if foundry workers had something to work for, some degree or qualification or status similar to that of the sea-going engineer. The apprentice moulder, at the end of his time, should go through a simple examination and obtain a third-class "ticket," and progressively should he be able to get his second- and first-class ones. Super or extra tickets should be available for those who showed a knowledge of practical science.

This Institution could appoint examiners to hold periodical examinations at the various Branch centres. I think it would raise the whole tone of foundrywork and tend towards better wages and more orders.

Proceedings.

The success of this Institution has been brought about by the efforts of a few hard-working foundrymen, and the majority, apart from being members, contribute little towards it. What is the result? The main result is that the Institution has been unable to do many things it should have done and wanted to do. I will detail some of these things.

Your transactions are printed and bound in such manner as to be almost valueless, they are not indexed, and are issued about eighteen months late. What I say to-night and what other speakers say this session will appear in transactions reaching you, at the normal rate of progress, late in the autumn of the year after next year—namely, September or October, 1924.

Test-Bar Research.

The inquiry into the question of cast-iron test-bars is yet another matter. After years of inaction something is started now when it was almost forced down our throats.

Then there is our lack of literature, of abstracts from the foundry work of the world at large, of an information bureau.

Pig-Iron Buying.

Finally, the deplorable position that the foundryman has to purchase such pig-iron as he may be able to afford and to accept it even though it may be far different to its published description; this without any hope of any complaint being of the slightest use. Alternatively, if he wants pig-iron or something approaching a known composition he has to pay an absurd price for it. In one and all these things we have been deplorably apathetic and lax.

Road to Progress.

It may be said that want of money is the cause. I do not believe it. *Want of keenness is the cause; want of money is the effect.* Past history has always proved it to be the case that wealthy men are attracted by the keenness of poorer men and come forward to help their institutions. Demonstrate that you are keen and the rest will follow. We have hardly commenced work yet so how can we expect to be rich. Let us support those who have done so much for this Institution. Let Newcastle Branch set the example. We have about two hundred and fifty members. Why not five hundred? It only means each of us bringing in another one, and some could bring in a dozen if they put a little real enthusiasm into it.

On our books are less than forty boys and ordinary moulders—the very ones we can benefit most we have least of. We should remember that *this is every foundryman's Institution, not particularly our own.* Every employer in this district should become alive to the unique value of

this Institution as an educational school for foundry workers. Managers and foremen should realise that it is their duty to encourage constantly their likely men and boys to join our ranks.

I wish foundrymen would do more reading. The Foundry Trade Journal and books like Moldenke's "Principles of Ironfounding" are far more fascinating than the football news and far cheaper than correspondence school courses. If any man or boy tries diligent reading for one year and then will look at himself I guarantee he will have a shock. Life for him will have become more interesting, more hopeful; he will be serving his country and himself. Shrug our shoulders and we go to the devil and our trade abroad; buck up and the Britisher and his goods are second to none. A member of a society who says nothing and does nothing is like a sovereign at the bottom of the ocean, perhaps a good one, perhaps not, nobody can find out.

I have had many complaints that this Institution and its Branches are "run by" a select few. Then why not start *to discover yourselves* and bring your best men to the front. Night after night in every Branch the same handful of men keep the discussions going, many of you probably know heaps more than these men, but how are we to find it out if you refuse to be discovered.

The last man who criticised us in that way was told by me that he had better start in and do something. Apparently he had not looked upon it in that light before, and the result is that he is giving us a paper this session, and later on he will be helping in our education scheme. Education in our Branch is going ahead this session. It *must* go ahead.

By the interest and kindness of Mr. Summers Hunter you are invited to inspect his works and laboratory. Afterwards, in this hall, I am giving an elementary lecture upon cast iron. A copy of this lecture will be sent to each of you beforehand so that you may read it and keep it. Also we have an educational paper upon dry-sand moulding; another one upon microphotography, telling you how it was done and what the photographs mean. Many lantern slides will be shown at these lectures and they should be very interesting and exceedingly instructive. Also we have the Surtees medals to be won this session.

I appeal to employers and others to give us donations towards the cost of hall, prizes, and so forth, for these educational nights. *It is essential that we have one once every month.* The cost would be trivial, and I feel sure my colleagues on the Council will gladly appoint a committee to deal with this matter. Also I feel sure we can obtain practical men and theoretical men willing to teach us and the lads. Let those interested write to Mr. Rang or myself.

All we need is your enthusiasm and patriotism. We shall get the help we need if we show that we are keen and determined. Foundry work cannot flourish without education, and things are getting worse.

Many of you will wish to attend such evenings, and many of you will be capable of helping in some way or another, by giving lectures, by bringing your lads, and so. If you have any ideas or suggestions please put them forward.

The Work of the Secretary.

This Newcastle Branch depends, and has always depended, upon one man. He has been its one constant source of energy, of unity, and of resource. I often wonder what it must have cost him in time and thought and money. He arranges the whole thing every year, he invites talented men to come and talk to us, he entertains them before and afterwards, he does all the correspondence, the literature, the accounts. The one thing apparently that he does not do is to put himself forward or make a song about it. I ask you to realise what our Secretary has done for us, for our Institution, and for our industry. I want you not to forget it, as I shall refer to it later.

There is no greater contentment than is his who does his level best. It is said that that explains why so many men are discontented nowadays—it may well be true. Get into any lad the doctrine of doing his "level best" and you need worry no further about him. It should be taught and taught again in every church and school in the land. Give your lads a chance *to like work*. To do so is their only hope of happiness and contentment.

I have heard it said at foundrymen's meetings that the boys are ungrateful young devils, and that one gets no thanks or return for what one does. That is utterly and absolutely untrue. Do your bit to the very uttermost, and you will find plenty of thanks within your own heart.

Vote of Thanks.

Mr. Wise, in proposing a vote of thanks to Mr. Young for his excellent address, said that he could not let the occasion pass without deploring the tone of pessimism adopted by Mr. Young. He considered that if the Germans did use science then the British used it even more, and though perhaps the Germans did make progress, nevertheless it must be remembered that they lost the war. He did not think that anyone would say that the German scientist or chemist was any better than the British scientist or chemist. Then with regard to the education of boys, he thought that it was most difficult to get boys in the foundry to take an interest in their work, although great efforts have been made in that direction, but in the future he hoped there would be better results.

Mr. Smith, in seconding the vote of thanks, said that he thought everything Mr. Young had said was possible. He agreed that if a boy made up his mind to do a thing well he could do it. He considered that it was the duty of the older men to help the boys to take more interest in their work.

Mr. Young said he had been told that his address was pessimistic, but no mention was made of the fact that he had said that if the Britisher would buck up he and his goods could beat the world. He considered the Britisher *could* beat the world not by waving the flag and talking about his abilities, but by trying to recognise where he is deficient and working to improve himself. Our boys must be encouraged to work hard, and if the Branch would help by giving educational evenings then, perhaps, at the end of the session he would not be so pessimistic.

Contracts Open.

London, E.C., October 16.—Wheels and axles, for the Bengal-Nagpur Railway Company, Limited. 132, Gresham House, Old Broad Street, London, E.C.2. (Fee, £1 1s., not returnable.)

London, S.W., October 17.—Supply of 1,200 steel tyres for carriage and wagon wheels, for the Madras and Southern Mahratta Railway Company, Limited. 25, Buckingham Palace Road, Westminster, S.W.1. (Fee, £1 1s., not returnable.)

London, W.C., November 15.—Supply of 1,500 galvanised iron or steel tubular poles for telegraph poles, 20 ft. long, schedule 755. Supply Officer, Room 101, Australia House, Strand, London, W.C.2.

Perth, W.A., November 15.—Supply and delivery of 1,490 galvanised tubular poles, for the Postmaster-General's Department, Perth. The Department of Overseas Trade, Room 47, 35, Old Queen Street, London, S.W.1.

Wellington, N.Z., November 28.—Supply of plate girders for the Orepuki-Waiau Railway. The Department of Overseas Trade, Room 50, 35, Old Queen Street, S.W.1.

Wellington, N.Z., October 6-December 12.—Supply of plate girders required for the Lawrence-Roxburgh Railway and the Taneatua Railway. The Department of Overseas Trade, Room 50, 30, Old Queen Street, London, S.W.1.

Mr. David MacLain sails for the States from Liverpool next Saturday. He hopes to pay England another visit next spring, as the tour just ending has been marred by ill-health.

The Royal Metal Trades' Pension Society are holding their annual whist drive in aid of the funds on Saturday, November 4, at the Finsbury Town Hall, Rosebery Avenue, E.C.1. Mr. H. G. Butcher will be in the chair, and will also act as M.C., while the hon. secretaryship is as usual in the capable hands of Mr W. Farmer, 195, Upper Thames Street, E.C.4.

Large Vertically-Poured Castings.

By S. G. Smith.

The castings described in this article are a few examples of important castings which are water-pressure tested, and are required to have clean and sound flange surfaces, except that illustrated in Fig.1. This is an internal flange cylinder, which, whilst not calling for a pressure test, does require the flanges to be quite solid and clean. The dimensions show it to be of medium size. It will be noted that a dross head, not a feeding head, is employed. This is quite necessary to obtain a solid top-flange after machining.

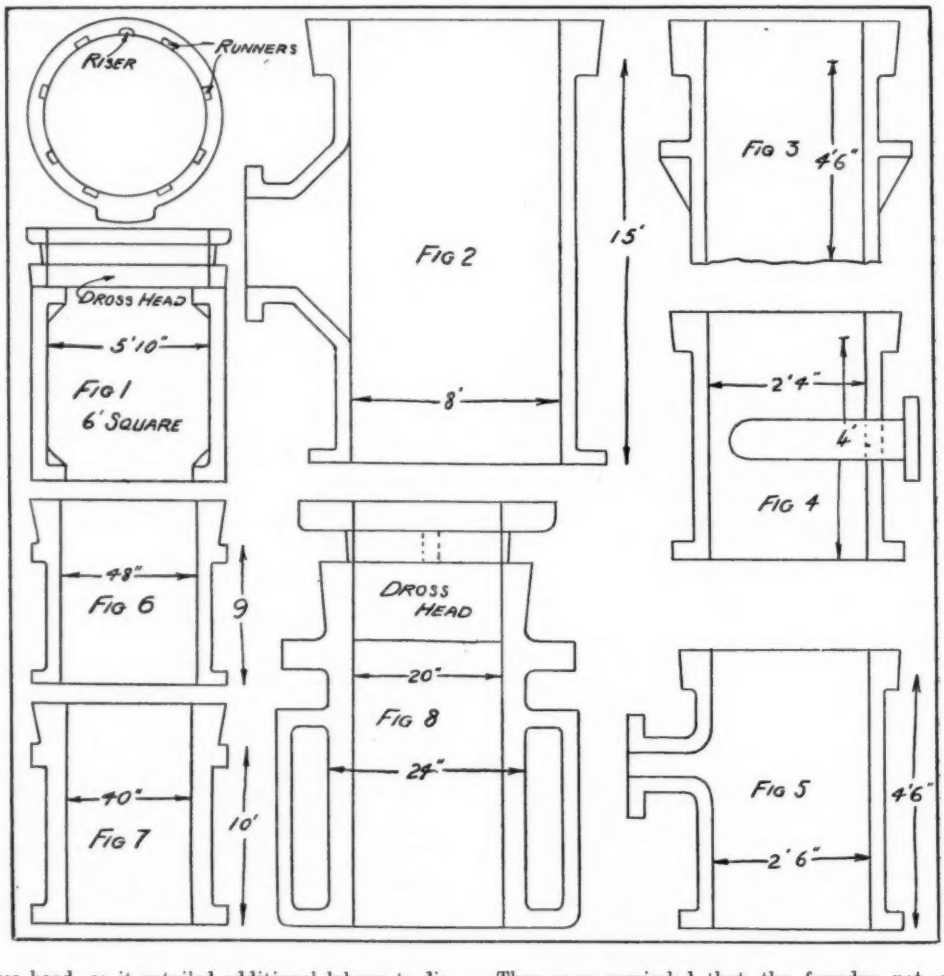
It may be interesting to recall that one firm having obtained a large order for this type of cylinder essayed to make the castings without a dross head, as it entailed additional labour to discard it. In brief, the result was a dirty flange, and the foundry foreman lost his position. This incident is recalled in order to support that a clean top flange, either internal or external, cannot be guaranteed unless a head is applied. Defects in castings of this type that would at one time pass inspection without comment will now often be rejected.

Fig. 1 shows the location of the small flat runner-gates. They are of 1¼ in. by ½ in. section. The number and size of these are usually determined by the temperature of the iron. Owing to their large area, the castings must be poured quickly with a fairly hot and fluid iron.

The foregoing remarks are equally applicable to the surface-condenser shell shown in Fig. 2. Such castings can create trouble. For instance, on one occasion, objections had been raised by those in control of the machine shops to a dross head being applied to the top flange of the condenser. The objection was based on the difficulty and time spent in handling such large pieces. This attitude was maintained in spite of the fact that for years much trouble had been experienced on water-pressure testing owing to the difficulty of obtaining a good flange at one end of the casting. This end, without exception, was always the top flange, as poured.

The writer ascertained from the machine shop that it was quite possible to cut off the dross head. All that was involved was a few hours' time and labour.

In possession of this information, the writer pointed out that the sizes, design, etc., of these castings were decided in their own department.



They were reminded that the foundry not only handled these castings, but manufactured them from pig-iron, which involved the use of tackle twice the size on the condenser.

As a last resort, the writer insisted that no responsibility would be accepted by the foundry unless the dross head was cast on. This ultimatum was considered by the management, who reluctantly permitted the suggestion by the foundry to be put into effect. Scores of condensers have been made since that time, but not one casting has given trouble under pressure test, or developed defects on the top flange as poured. What has just been stated applies profitably if the casting is machined and not pressure-tested, or, if the casting is not machined and pressure-tested, the precaution (if a little inconvenience and expense is entailed) of putting on a head always favours a good casting.

If it be a flanged casting, such as the above sketches show, the question of section and depth of head is important. Generally speaking, this

may be determined by the thickness, and in some cases the length of casting, but that is not so in the present cases. These castings average 1 in. thick, the flange 1¼ in. thick. The joints are machined and pressure-tested.

It will be noted, with the exception of the 9-ft. flange pipe, that the length of the head, including thickness of flange, is 8 in. To ensure soundness in the flange, this thickness must be taken as a minimum; it will just cover the possibility of porosity due to several causes, also it will be ample to receive the accumulation of doss and dirt. If when the head is cut off the flange is not sound and clean, there is something very unusually wrong.

The chief reason for the head being the width of the flange is simplicity and convenience in moulding for occasional castings, whether in loam or sand. When similar work is required in large numbers, then it would be both advantageous and economical to adopt a design of head such as is shown in Fig. 6, which would necessitate a pattern, if made in sand, but in loam a separate head would need be swept up with a suitable strickle.

From experience with vertical poured castings of almost all descriptions, it can be stated that it is inadvisable to put two or three inches of head on a top flange, it being far better to allow only half an inch. Good fortune in having very favourable conditions may sometimes result in a good clean top flange without a head as suggested, but it will only be occasional.

Referring now to heavy sections of vertically-poured work, such as hydraulic castings, rams, cylinders, etc., any of these may have a mean thickness of from 2 to 4 in., whilst the flanges in some instances exceed 6 in. in thickness. To make such castings water-tight under very high pressure, it is necessary to have much larger dimensions for the feeding heads than those indicated. Also with heavy sections a very much denser iron must be obtained. For castings 1 in. thick a clean ordinary iron, which, in fracture appearance, is between a No. 3 and a No. 4, approximating to the following analysis:—T.C., 3.75; Si., 2.00; P., 1.25; Mn., 0.60; and S., 0.06 per cent. This would meet all requirements, but to make water-tight under pressure, castings from 2 to 5 in. thick would require a very much denser iron. The density should vary directly with the thickness, *id est*, the combined carbon should be increased and the total carbon reduced. A suitable analysis would be:—T.C., 3.00; C.C., 0.70; Si., 1.00; P., 0.75; Mn., 0.75; and S., 0.10 per cent.

The following figures will give some guide regarding the area and depth of head in relation to thickness and section of casting. They are not theoretical, but actual, in practice which have produced satisfactory results.

Fig. 7 is a double-flange casting 10 ft. long, 40 in. dia., 2¾ in. thick, and with flanges 4 in. thick. The flanges were very heavily bracketed, the pitch being 6 in. and the drilled holes centres it. These castings were required to stand an enormous head of water, hence the abnormal thickness. The design of the feeding head, as shown in this figure, is 18 in. long. The moulds were bricked up in loam, and the cores swept up on a barrel. The area and depth of heads for hydraulic pipes would be between those shown in Figs. 6 and 7.

Fig. 8 is a large vertical gas engine cylinder of the jacketed type. The bore being fairly thick and the jacket encircling the greater length, retards the cooling considerably, hence a feeding head of adequate size is needed, and obviously the iron must be dense.

The castings enumerated in this article are chiefly poured with small runners from the top, as shown in Figs. 1 and 8. When convenient, a small runner is carried to the bottom, or part way down, to minimise the splash from the drop. This would apply to Figs. 2 and 8, but not to Figs. 1, 6 and 7.

B.R.C. Fabric, made by the British Reinforced Concrete Engineering Company, Limited, of Manchester, is at present being used for reinforcing the concrete foundations in a portion of Trafalgar Square, London.

Remaking a Cyder-Press Nut.

By S. Cooper.

It has been said, the majority of moulders are imitators. In a great many instances this may be true, but quite often it is found that they have unconsciously been copying a method that was employed many years ago, whilst thinking they were creating an innovation. The following article illustrate this. A and B Fig. 1 represent parts of a cyder press, the latter being a nut, or really the boss of a wheel which is screwed along the steel shaft A. This gives the necessary pressure to reduce the apples to pulp, producing the juices for cyder making. This particular press had been in use a number of years with the result, the threads of the nut were entirely worn away, although the shaft was in very good condition. The job was given to a small country foundry to make the new centre B. It would be a simple job to make a casting and machine-cut the thread, but the foundry, having no machine-shop, could not cut threads, especially of such a size. Additionally it could not afford to have it machined outside, as the nearest works was 12 miles distant.

After considering the matter carefully, the foundry was told to do their best. After burning off the grease from the old casting, it was used as a pattern. A mould was made, jointed along the centre, carefully finished, and for safety, skin dried. Having had some little experience of burning and casting on, it was decided to use the shaft A in place of a core. The shaft was also carefully cleaned, made hot and coated with tar. When the tar had dried hard it was placed in position in the mould and cast. Expecting trouble through the

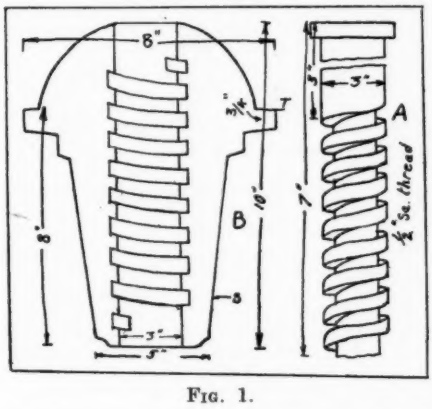


Fig. 1.

metal blowing, a flow-off riser was used, the metal flowing through until everything was quiet. As the shaft became warm the trouble ceased. As soon as the metal became set, it was intended to twist the bolt out of the casting. This could not be done, and the job was left over-night. The following day, when everything was cold, it was possible to move the nut about ½ in. only. From a casting point of view the job was sound and perfect. Therefore, for examination purposes, the casting was broken off the shaft with a sledge and fortunately no damage had been done to the bolt or threads. On re-examining the shaft closely, the cause of the trouble was found to be that although the threads of the shaft appeared to be perfect, there were variations in the size, the maximum being 1/16 in. In addition, there were several small flats in places, which acted similarly to a key on a shaft. This was the cause of the nut refusing to leave the shaft. It was ascertained that this shaft had been in use about 100 years and further, that it had been cut by hand. It was truly a first-class piece of work.

As the foundry wished to produce a piece of work equally as good it was decided to try again. This time the blacksmiths aid was requisitioned. A piece of steel, measuring 1 in. × ½ in., was heated in the forge, and using the bolt as a template, a spiral, was made which could be wound the length of the bolt. A rather slack fit was thus obtained. The coil was made 8 in. long. Taking a core-box 4 in. dia. by 12 in. long, the core was carefully rammed up 2 in. The spiral of steel was

then dropped in the core-box; as the spiral was 4 in. in dia., the core-box kept it perfectly upright and central. The necessary rods for strengthening and venting the core were then placed in position and the remainder of the core rammed to the top of the box. After the core was dried it was carefully rubbed down to 3 in. dia., wet blacked and dried. This gave a core with ½ in. of thread protruding, and the same amount embedded in the core. A further mould was made, but this time on end, and two joints being used for convenience, shown at S and T, Fig. 1. The joint at S being for running purposes. When finished the mould was cored, but prior to this, all blacking was cleaned from the spiral attached to core. As the job was cored several hours before casting the steel work was just touched with oil to prevent dampness. When cast the metal peacefully filled the mould, showing not the least signs of a boil. Next morning a first-class casting was produced, and after being carefully cleaned inside the cored part, a little grease was used to lubricate the threads, and the nut was screwed the full length of the shaft without the least shake or side-play. It will be remembered the spiral was made rather on the slack side, this was to allow the contraction to close it slightly, and just the amount required for the purpose happened to be struck. The contraction of the casting held the spiral safely and firmly in place. No fusion of the two metals, of course, would not take place. The job was an entire success, and after seeing the great pressure and the rough usage to which the screw is subjected, the writer was inclined to be glad the casting in the first instance was a failure. We doubt if it would have held up as the one with the steel threads has done. On tackling this, it was thought that the foundry were using an innovation by using a steel thread. Nothing could be seen of a thread in the old casting, but when it was broken, the old one exhibited the very same method. Thus many years ago, there had been embedded in the cast iron a steel thread ½ in. × ½ in. After all there may be some truth in the saying moulders are imitators, consciously of unconsciously.

Casting Ball-Races.

Ball-races are usually made from chromium steel. In England, apparently, two specifications are used, the better grade containing 1.25 per cent. carbon and 1.5 per cent. chromium, whilst the cheaper grade has 0.90 to 1.0 per cent. carbon and 1.25 per cent. chromium. In France the writer only found one specification which approximated the mean of the two British ones.

A recent innovation in the manufacture of this steel has recently been brought out by Mr. L. Cammen, who describes his results under the caption of "Chromium Alloy Steel Cast Centrifugally" in a recent issue of the "Iron Age."

He points out that ball-race steel, when cast in an ordinary ingot mould, has a clearly dendritic structure, with large coarse grains, and the carbide is almost entirely in solution.

When centrifugally cast, the alloy is stated to show the same grain on annealing as a forged billet. It opens up important possibilities, and shows that it is possible to cast steel in such a manner as to avoid the dendritic ingot structure.

Mr. Cammen now claims it is now possible, at least for ball-bearing race steel, to produce by simple casting and annealing a material equal in structure to a forging, and thus eliminating the forging operation.

The possibilities of centrifugally casting are immense. Readers of this Journal are familiar with the fact that cast iron so treated gives a superior structure associated with better mechanical tests.

The manufacture of railway tyres was dealt with in our last issue.

Threatened Stoppage on North-West Coast.

There is a grave danger of a complete stoppage of all the blast furnaces in Cumberland and North Lancashire owing to the breakdown of negotiations between the West Coast Ironmasters' Association and the Wages Committee of the Cumberland and Lancashire District of the National Union of Blastfurnacemen.

Association Technique de Fonderie.

The Nancy Conference of French foundrymen was opened last Thursday under the chairmanship of Mons. Ramas. The address of welcome was delivered by Mons. Masson, president of the local reception committee. The first day was devoted to the reading of four Papers. The first dealt with "Some Factors in Cupola Practice, Influencing the Quality and Strength of Cast Iron," by C. Kluytmans. This was followed by two Papers by Mons. Siegle, the first being "A Thermal Study of the Cupola," and the second, "Inspecting Foundry Raw Material." The last Paper was by Mons. Ronceray, and outlined some work on the malleabilising of white iron by two American investigators, Messrs. White and Gladhill, of the University of Michigan. The afternoon was spent visiting works.

On Friday Mons. Leonard, the President of the Belgian Association, was in the chair. Mons. Ramas then outlined Réaumur's work on malleable cast iron, as this year is the great inventor's centenary. The following Papers were then presented:—(i) "Malleable Foundry Work" (results obtained since the 1921 Liège Congress), by Mons. Marcel Remy. (ii) "A Contribution to the Study of Testing Malleable Iron," by MM. Remy and Piedbœuf. (iii) "Practical Points in the Working of Side-Blown Converters," by Mons. Levoz. (iv) "Malleabilising White Iron," by Professor A. E. White. This Paper was the official American Exchange Paper. (v.) "Ascertaining Foundry Cost Prices," by Mons. Masson, foundry manager, Messrs. A. Ketin, of Sclessin. This was the Belgian official Exchange Paper.

Friday afternoon and Saturday morning were taken up with more visits, the business meeting not starting until 2 o'clock, when Mons. Damour presided. Only three Papers were read at the session, the first being by Mons. Brasseur on "The Electric Furnace and the Brass Foundry." The second deal with "The Influence of Phosphorus on Brass," by Mons. Portevin; and the third related to a new light aluminium alloy called "Alpax," by Mons de Fleury. At 4.30 Mons. Ramas took the chair for the adoption of the balance-sheet and other business. The banquet was held on Sunday evening.

Some abstracts of the Papers are to be found elsewhere in this issue.

Community of Interests in the German Metal Industry.

The Commercial Secretary at Cologne reports that according to the "Kölnische Zeitung" for September 13, it is understood that the negotiations which have been carried on for some time with a view to the formation of a large community of interests between the leading German nickel, aluminium and other metal rolling works have in so far been successful that the supervisory boards are to meet within the next few days to draw up propositions for the consideration of the general meetings to be held in the near future. The community of interests will be formed under the leadership of the Verein deutscher Nickelwerke A.G. at Schwerte-Ruhr. The firms C. Heckmann, Kupfer-und Messingwerke A.G., Duisburg and Berlin, the A.G. Selve, Altona, and several other South German and other firms of the same or similar nature will join the community of interests. The independence of the companies as share companies will remain. The union provides in particular for the joint purchase of raw materials, the joint sale of the products, and other measures which will greatly lessen competition. It is further intended to collect the total profits every year of the works united in the community of interests in the same way as is done in the aniline group, and then to distribute them amongst the various works in a proportion based upon the amount of the share capital.

CONSIDERABLE damage was done by a fire which broke out recently at the works of the Agra Engineering Company, Old Quay, Teignmouth.

Cupola Melting Tests, with Mixtures Changing During Run.*

By Richard Moldenke, Watching, N.J.

[Slightly abridged.]

As the foundryman oftentimes is confronted with the necessity of running special charges in the first part of his heat to turn out castings of a different character than his regular line of production, he will be interested in knowing what are his chances of keeping the several mixtures separate. The comparatively higher labour costs in America preclude the running of a series of small cupolas, each with its own mixture, as is done in Continental Europe, and hence the single, large cupola must serve with what protection a double-coke charge between the mixtures will give.

It is quite common to find two mixtures run in the day's heat, and occasionally one finds three of them, depending upon the lines of work to be catered for. The smaller tonnage is always put through first, to get it out of the way, and if there are two mixtures for small amounts to be handled, the harder one is charged first. As such extra mixtures usually contain steel scrap—some of them high percentages—it is advisable to make the first charge, one without steel or fine scrap. In the first case the melting steel falling upon the cold bottom will surely stick, and in washing away as the heat progresses affect the succeeding charges unfavourably, apart from giving the first ladle of iron without much benefit from the steel used. In the second case, with fine scrap in the mixture, this will melt quickly and drip down on the bottom before the heavier sectioned iron melts, and thus give an erroneous impression of the height of the bed by yielding a flow of molten iron several minutes too soon.

With the first charge out of the way and the bottom well heated by this iron, and the second charge with its steel first, pig next and lighter scrap on top in uniformly spread layers, an even melting should take place as far as this may be carried out in the cupola process. Placing at least a charge and a half, if not a double charge of coke between mixtures, and pouring the transition metal into work that will be satisfactory with both mixers, a reasonable degree of success can be attained.

Tests with Nickel Chrome.

However, foundrymen will have noticed that the separation of the several mixtures is not nearly as effective as can be wished. For instance, where several charcoal iron charges, having a low phosphorus content, are put into the cupola first, and after putting on a double-coke charge, the subsequent higher phosphorus iron charges go on up to the charging door, it has been noticed that the phosphorus content of almost the first iron is higher than it should have been. This shows that some of the upper charges must have melted along the lining of the cupola, and contaminated the purer iron of the lower charges. Instances of hard iron where soft was expected, and *vice versâ*, are common knowledge in the foundry. The analyses in a series of tests recently made with Mayari pig-iron, which contains nickel-chromium, showed this intermingling of charges so plainly that it was deemed important enough to present to the foundry industry in form of a short report.

An extended research was made for the Bethlehem Steel Company, on the characteristics of their Mayari pig-iron, made from Cuban ores carrying nickel and chromium. The composition of this pig-iron runs about as follows:—

	Per Cent.
Silicon	0.50 up to 3.00
Manganese	0.90
Sulphur	0.03
Phosphorus	0.065
Nickel	1.20
Chromium	2.40
Titanium	0.18
Vanadium	0.05
Total Carbon	4.00

*A Paper presented before the Rochester Meeting of the American Foundrymen's Association.

From this composition it will be seen that the nickel-chromium content is a prominent characteristic, and being so different in this respect from any other pig-iron of the country, it is easily traced in its behaviour in the cupola by the analysis of the metal made. With titanium reduced from the ore, and an almost negligible sulphur and phosphorus content, for cast iron, this pig-iron stands out as rather exceptional. It is gratifying to know that about 500,000,000 tons of this ore is in sight on 25,000 acres in Cuba.

Cupola Tests.

In making up the charges for the cupola, the first one was arranged to contain no Mayari pig-iron at all. The second charge, separated from the first one by twice the amount of coke needed, or using a ratio of 5 to 1, instead of 10 to 1, contained 10 per cent. Mayari pig-iron. The third charge had 15 per cent. Mayari, and was similarly separated from the second charge. The fourth charge had 20 per cent. Mayari iron, in similar manner. Where a fifth charge was run, this consisted of whatever mixture was found convenient, usually with steel to reduce the total carbon. It will be seen, therefore, that the charges were much more widely separated than would have been the case in charging the same mixture repeatedly, and, therefore, melting could be expected to be fairly separate. It was only after the trial was made in foundry after foundry that resort was had to the crucible department of the Bethlehem Steel Company, which generously detailed an entire unit of its large regenerative furnaces, holding 24 crucibles at a time, for this purpose.

In order to have the results as comparable as possible, even the scrap used was first made by remelting a standard pig-iron in 5-ton batches. A mixture of 60 per cent. pig and 40 per cent. scrap was used in every case, the Mayari pig-iron forming part of the pig, when it was used. The laying-out of the mixtures need not be gone into here; it is sufficient to say that every effort was made to have the programme as exact as this could be made consistent with ordinary foundry routine. The charges varied from 600 to 2,000 lbs. each, depending upon the cupola of the particular foundry. The surplus metal went directly into castings. Two sets of cores arranged for three test bars each were poured off for each mixture, the cores being parked together and rammed up in a flask. The A. S. T. M. arbitration bar, 1¼ in. dia., and 15 in. long, poured vertically, was used, being afterward tested for transverse strength and deflection on supports 12 in. apart, for tensile strength, and for hardness by the Brinnel test. Micrographs also were taken. A complete analysis was made for each set of bars of a mixture.

The following figures summarise the results:—

Charge No.	In Mixture Ni.	In Mixture Cr.	In Castings Ni. Aver.	In Castings Cr. Aver.
1	0.00	0.00	0.10	0.23
2	0.12	0.24	0.11	0.28
3	0.18	0.36	0.10	0.27
4	0.24	0.48	0.10	0.28

From this table it will be observed that with perfect bed conditions in each of the four foundries, "first iron" over the spout coming in 10 minutes in each case, and with twice as much coke between the charges as need have been in ordinary practice, yet the Mayari pig-iron must have melted (and the other pig-irons—also machine cast—with it) from the upper charges before the lower ones were gone. The above figures are the averages of a series of melts in each of which the regular progression of charges contained the nickel-chromium content as stated. What would have been the result had the usual 10 to 1 ratio of metal to coke been used can only be conjectured. Melting could not have taken place within the middle of the upper charges as the only oxygen likely to be pre-

sent above the melting zone would be close to the lining of the cupola. That melting does take place far up in the cupola at the lining is often observed by the foundryman when the nature of the scrap keeps the charges open. Thus, in making brake-shoes with heavy percentages of stove plate scrap, and where on occasion an entire stove finds its way into a charge, iron can be observed melting a foot or two below the charging door, with the entire rim of metal red hot.

The only conclusion to be derived is that melting takes place much higher than is supposed, along the lining, and that it is of utmost importance to charge metal and scrap uniformly in their several layers, so that whether melting takes place in the upper charges or not, whatever does drop down will consist of the right proportions in the mixture. Again, that strict attention be paid to the order of charging—steel first, pig and heavy scrap next, and light scrap on top. Machine cast pig melts faster than sand cast pig of equal sections, because of the higher combined carbon in the first. Inasmuch as machine cast pig usually has a heavier section, this condition of melting usually equalises itself.

Further, the practice occasionally met with of placing all the pig of a mixture around the rim of the charge, and the scrap in the centre, cannot be condemned too severely. Cupola melting differs from all other methods in the peculiarity that intense heat is developed at the actual contact point of coke and iron. With the usual layering in charging, the proportion of coke to pig iron at the rim with the above mentioned practice, will be considerably smaller than it is in the middle, and hence coke will burn away too fast around the sides to give very hot metal, not to speak of it being oxidized. If it were not for mixing with extremely hot metal from the central portions of the cupola when the tap-hole is opened and the metal converges from all parts of the crucible, bad results would be had. As it is, many cases of alternating hard and soft castings, which look sound and have blow-holes side by side, can be traced to this bad practice when other charging conditions are correct.

Therefore, it can be emphasised that with all its advantages the cupola melting process has some draw-backs, one of which is plainly shown by the tests with nickel-chromium here described. Every attention must be given to the details of charging and blast conditions, so that however melting will consist of the right proportions in the mixture.

Major G. Fetherston, D.S.O., M.C., His Majesty's Trade Commissioner at Cape Town, is in attendance at the Department of Overseas Trade for a brief period, and will be pleased to interview manufacturers and merchants interested in trade with South Africa. Appointments with Major Fetherston can be made by application to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. The reference, 3932/T.G., should be quoted in all cases.

Electric Scaling Hammer.—An interesting demonstration of the Sandblom electric scaling hammer took place recently at the shipyard of Messrs. John Stewart & Sons, Limited. The efficiency of the hammer as a labour-saving device was amply proved by the removing of rust from the hull of a vessel on the stocks in one-sixth of the time taken by the hand hammer. The electric hammer weighs about 26 lbs., and consists of a hollow shaft through which a spindle revolves. At the head of the spindle a number of two-link chains with hammerheads are attached, and when the small electric motor coupled to the spindle is started the chains are thrown outwards by centrifugal force. The revolving spindle with its hammers is held so that the hammerheads come into contact with the surface to be scaled. The hammer can be handled by one man. It provides a rapid and efficient method of removing scale, rust and old paint from iron and steel work, such as bridges, boilers, etc. It is specially adapted for the cleaning of surfaces badly corroded and pitted, the small hammerheads following and entering all indentations and cavities and cleaning them thoroughly. One great advantage is that, where the hand hammer and the pneumatic chipper both leave cuts and indentations in the plates, the electric hammer leaves a smooth surface, and little, if any, brushing down is required before paint or other coverings are applied. The manufacturers are the Electric Scaling Hammers, Limited, 6, Broad Street Place, London, E.C.2.

Old Methods and their Present-Day Application.

By Ecossais.

Although plaster of paris is used freely in many foundries, there would seem to be still plenty of founders who do not realise its usefulness, and this notwithstanding the numerous articles and papers and demonstrations relating to its use.

It is proposed to deal chiefly, however, with the use of plaster for pattern-plates, for jobs which can only be mounted or cast on plates with difficulty. The chief advantage of cast-metal pattern-plates over mounted patterns, in the case of the same pattern, is the greater speed of producing it and its lower cost. When the pattern is of such a shape as to require a joint approaching right angles to the horizontal or box joint, the cast plate is out of the question, and with any steep angle the thickness of metal in this portion of the plate is much less than that of the body of the plate. With cast iron, even if the plate casts satisfactorily, there is always the possibility of early fracture. Aluminium might be used, but there are certain disadvantages in its use for plates, even if the shrinkage has been overcome and beeswax has not been required in quantity, unless kept well varnished or warm enough not to cause tearing and "clagging," due to its natural coldness.

With a pattern of a delicate design such "clagging" would, of course, necessitate knock-outs. If wax had been used, warming the pattern, unless very carefully done, will melt the wax and mean repairs. To overcome the steep joint in mounting as against casting on a plate, two

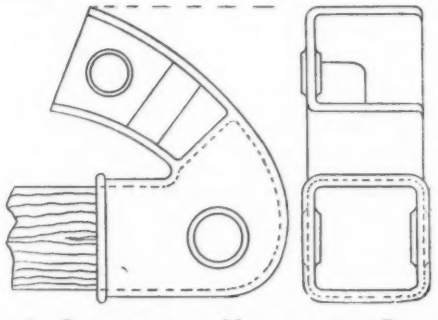


Fig. 1.—Illustrating a Method where Plaster Matches can be Advantageously Adopted.

plates, or a very thick plate, would be required, which would be so heavy as to mean wood being used instead of metal. By using plaster and casting a match on the top-box of a mould and one on the bottom box, with or without removal of pattern, two "plates" are available in a very short time, the steep joint presenting no difficulty, and showing the advantage that both parts can be worked simultaneously. This is, of course, not possible with a two-sided or ordinary type of plate.

It is frequently argued that plaster is easily damaged and marked, but with ordinary care it can be made to serve for a long period, alterations can easily be made and slight damage quickly repaired. When it is desired to work from plaster for a large order it is advisable to cast around metal patterns in both top and bottom box, provision being made by projections or screws for holding to the plaster cast around them.

White Metal Patterns.

A cheap, white metal is very suitable for the patterns, being easily filed up, and unlike iron or aluminium in that it does not rust or oxidise in the damp and steam prevalent in the foundry. In the event of a new plaster being required an impression can be taken off each part at the end of the day, the metal patterns from the old plaster put in position, cast, and washed when sufficiently hard, being varnished the following morning, although this may be done the same night within 2 hrs. of the plaster being cast. To hurry along the drying a light "brush-over" with methylated spirits will help, and by putting the "plasters"

in a draughty place, found in most foundries, the spirit will accelerate the evaporation of the surplus water. Drying in the stove is sometimes resorted to, but, in the writer's opinion, this weakens the plaster and shortens its life. So far as durability of plaster is concerned, this never gave much trouble to the writer, as patterns rarely had a run of over two months before becoming obsolete, being replaced by others of fresh design. Certainly in this case it was inadvisable to make expensive plates, and there was no difficulty *re* storing, as plasters were in commission for regular quantities right up to the times when superseded by the patterns of new design. In certain jobs which were worked with loose pattern, a plaster oddside with white metal gate patterns was used, this saving joint making and ensuring correct gating, as otherwise, owing to operators being on iron, aluminium, bronze or brass at different times, there was a tendency to err in the size of the different gates and lumps provided on them for feeding and skimming purposes. The method of making the gates was to make a complete mould and cut out the gate with care, replacing the patterns, and casting the gate right up to the patterns, with the top box in position. The top was afterwards removed, the gate carefully lifted and trimmed and replaced in position, plaster being cast around this and on the patterns in the bottom box in the frame used for the oddside. In use, the gate was left in the correct position on removal of the oddside after ramming up the bottom box.

In many cases, by using a wooden or even a metal frame for both cope and drag, match patterns can be made to leave their own cores in the correct position, with the metal thickness exact.

Sump Castings.

A case in point is the sump casting or lower half crank-case for motor-cars, usually cast in aluminium. Some foundries use a solid, or block pattern, and provide coreboxes for making the cores, usually green-sand. If the cores are not sitting sufficiently low, due to tight prints, the metal at the top will be too thin, or even mis-run, or, again, the core may be tilted over slightly. If the prints fit too easily the cores are always liable to be more or less eccentric, and the space between print and core requires making-up if extra chipping is to be avoided. This double-match method was also adopted in several other cases where there is a delicate wooden shell pattern liable to get distorted. With a wooden shell pattern, even if well varnished, and supported by a wooden block, the pattern is given every opportunity to warp, as one side is moist by contact with the sand and the other next the block kept practically dry. In such cases it was the writer's practice to make a complete mould of the pattern as soon as possible after receipt of the pattern, and cast two matches with the pattern removed. If a metal pattern was required, and double contraction provided in the original pattern, this was made first and the plaster made from this after being finished. As by making a metal pattern some little time is taken up before the job gets into commission, the procedure adopted by the writer in all urgent cases was to get the patterns made with one contraction and, if necessary, the job could be worked off in 2 or 3 hours' time. Among the jobs dealt with in this manner were small propeller fans for radiator cooling purposes, light boxes, both open and closed ends, light machine guards and small motor ends, small switch boxes and lids, and the panels in machine-tool sides. Another case where plaster saved some expense and delay was by the casting shown in the two views in Fig. 1. The job was intended to be cast in malleable, and to cover the time required to get deliveries from the malleable foundry a stock was worked up in bronze, and the patterns despatched by passenger train to the malleable castings concern. When the stock had been practically exhausted it was discovered that the patterns had never reached their destination, having been lost in transit. This meant new patterns and another long wait for deliveries. Whilst the patterns were being made a scrap casting was found, the core-print plugged with a print, and a couple of plaster matches cast, dressed and varnished 3 hrs. after the discovery of the loss of patterns. At the same time a core-box was cast in white metal in two halves on one of the cores, remaining from last order, with lugs to match for dowel pins. After drilling the lugs the box was parted, and cores rushed into the stove. By the time the moulder had made about six moulds his cores were ready, and two hours later six castings were delivered, followed by other deliveries at two hours and one-hour intervals. This was followed up the following day by larger quantities, as there were then plenty of cores available, and the situation was saved. This would have been almost impossible loose pattern, and certainly not by working from an old casting.

World's Output of Electric Steel.

Except in two or three countries practically no electric steel was made prior to 1913. In the United States, Germany and France, particularly the two latter, electric furnaces were making steel as early as 1908 and 1909. The industry, however, did not attain any magnitude until 1913. In that year Germany was its acknowledged leader.

Due to the stimulus of the war, the electric steel industry of all producing countries expanded until the peak was reached in 1918, when, according to "The Iron Age," over 1,140,000 tons was produced against only 168,600 tons in 1913. In this period, however, the United States gradually displaced Germany from the lead, with an output in 1918 nearly equal to that of the seven other producing countries combined. The output in 1915 was about 80 per cent. greater than in 1913, while in 1916 it was about 90 per cent. greater than in 1915. From 1916 to 1917 the increase was about 50 per cent., and from 1917 to 1918 the expansion was about 40 per cent.

In 1913 Germany produced over 50 per cent. of all the electric steel then made. Although the United States ranked second in that year, the industry had only just started. Germany and Austria-Hungary were credited with close to 70 per cent. of the world's output in 1913. But by 1918, although Germany had increased its electric furnace production about 2½ times, the United States output had expanded 17 fold. Their output was not only twice that of the two so-called Central Powers, but was nearly half the total of all the producing countries. Another feature of the development of this industry up to 1919 was the rapid growth of the British and Canadian production. In 1913 there is no record of any output in those countries, but in the four years 1915 to 1918 inclusive, the British electric-steel industry had expanded five fold and the Canadian about 21 fold.

The progress of the industry as a whole in the readjustment period since the war, or in 1919, 1920 and 1921, has varied with the peculiar conditions existing in each country. Despite the falling off, the 1919 total for six countries was larger than the 1916 total for eight nations. The 1920 total for six countries, assuming Germany to have made as much as in 1919, exceeds the 1917 output for eight. In 1921, the year of world-wide depression and strikes, probably over 425,000 tons was produced by the six countries, including Germany, or a figure nearly equal to the output of 1913 and 1915 combined. The following table excludes any post-war returns from Germany and Austria, figures not being available:

Output of Electric Steel Ingots and Castings in the Leading Countries in Tons.

Country.	1913.	1920.	1921.
United States ..	30,180	502,152	169,499
Germany	88,256	—	—
Great Britain ..	None	89,100	27,100
Canada	None	28,301	16,844
Austria-Hungary ..	26,837	—	—
France	21,124	58,080	24,457
Italy	—	*100,000	*140,000
Sweden	2,276	—	—
Total	168,673	777,633	377,900

* Estimated.

The Trend of American Specifications for Steel Castings.*

By E. R. Young.

One of the mooted questions in the steel industry and one which concerns the steel-casting manufacturer is the question of the limits of phosphorus and sulphur. Earlier specifications set these limits at 0.050 per cent. for acid open-hearth steel, and these were commercial up to the time of the war demand. When fuel and melting materials which would yield a finished product under these limits became difficult to secure and were needed for types of steel in which low phosphorus and sulphur were of vital importance, the phosphorus and sulphur limits for steel castings were raised to 0.06 per cent. for acid steel. These limits were tentatively continued in 1919 and were adopted as standard in 1921 by the American Society for Testing Materials. Some purchasers, however, are still loath to adopt this new limit. The findings and recommendations of the joint committee on phosphorus and sulphur in steel which is now making an exhaustive study of the subject will undoubtedly prove the limits of 0.06 per cent. to be entirely proper for steel castings and will probably justify a more liberal limit. It is to be hoped that this report, when forthcoming, will be of such a nature as to be conclusive on the subject and that it will be accepted as standard by all.

The objection of the average engineer or metallurgist to steel with phosphorus and sulphur over 0.05 per cent. or 0.06 per cent. is based partly on tradition and partly on a mental reservation regarding the shock strength of the material. It is this objection to phosphorus and sulphur based on tradition or perhaps even on prejudice which the findings of the joint committee will surely answer.

Table I.—*Comparative Tensile Properties of Heats.*

Classification of Heats.	Physical Properties.					Analysis.				
	No. of heats.	Y.P. Tons per sq. in.	M.S. Tons per sq. in.	Elongation. Per cent.	Reduction. Per cent.	C.	Mn.	Si.	P.	S.
Heats high in sulphur (0.070 or above)	209	20.0	35.7	22.4	28.7	0.29	0.71	0.30	0.045	0.076
Heats low in sulphur (under 0.055)	110	20.1	36.6	22.2	29.0	0.30	0.70	0.30	0.044	0.052
Heats high in phosphorus (0.055 and above) ..	32	19.5	36.1	21.7	28.0	0.30	0.72	0.31	0.056	0.061
Heats low in phosphorus (under 0.040)	74	19.9	35.8	22.8	29.9	0.29	0.70	0.29	0.037	0.065

Phosphorus from 0.04 per cent. to 0.06 per cent. and sulphur from 0.05 to 0.07 per cent. do not affect the static properties of annealed steel castings, that is the properties determined by the usual tensile and bending tests.

The writer has the data on the physical properties and chemical composition of 1,036 heats of ordnance steel (cast steel No. 2 and No. 3 U.S. Army specifications) made by the converter process, which has been analysed to detect any variation of tensile properties with the phosphorus or the sulphur content. Four divisions or classes were made as is shown in Table I.

The heats were segregated according to this classification and the average tensile properties and chemical composition of the heats in each class were computed. Table I. gives the average properties and composition, and the number of heats included in the average in each case.

The average properties show a sensitive relation to the carbon and manganese content as would be expected. There is no suggestion of any relation to the phosphorus or the sulphur content with the possible exception of the value for yield point for the high phosphorus heats which is slightly out of line with the other average properties for these heats. This is very likely due to the average including a relatively small number of heats, and so, being unduly affected by a few low values; but, in any event, the decrease is well within the limits of error of testing and therefore unimportant.

Results of a short series of impact tests have been published which show a marked falling off in dynamic or shock strength, between 0.06 and 0.07 per cent. phosphorus.† However, considering the somewhat uncertain standing of this test in the field of testing materials and, especially, the small number of tests included in the average results, it does not seem that this evidence on the subject can be regarded as final.

The writer has seen screws, bolts, etc., made of screw stock with phosphorus and sulphur both over 0.10 per cent., tested to destruction, without any weakness of material being disclosed. He has also seen steel castings with phosphorus over 0.06 per cent. and sulphur over 0.075 per cent. tested to destruction with no suggestion of weak or faulty material, though the uninitiated would confidently expect such tests to show the material to be decidedly inferior.

The final answer to the question of shock strength is the test of service. Perhaps there have been cases of failure of steel castings used under severe shock conditions, which have shown a high content of phosphorus and sulphur in the broken parts. Supposing that these failures have been shown to be due to faulty material and not to foundry defects or to excessive loading, the remedy is still not lower phosphorus and sulphur, but proper heat treatment. In the writer's opinion this has been conclusively shown by the work of Mr. John H. Hall and associates on the "Heat Treatment of Steel Castings."‡ They have shown that the lines or planes of weaker material, due to the non-uniformity or segregation promoted by phosphorus and sulphur, can be removed by quick cooling from the annealing heat, followed by reheating at the proper temperature, but cannot be prevented from forming slow cooling from the annealing heat, by any lower content of phosphorus or sulphur down to 0.025 per cent.

Further evidence that an extremely low content of phosphorus and sulphur is necessary before any gain is made in the properties of carbon steel is given in an article detailing the practice of the U.S. Naval Ordnance Plant at Charleston, W. Va., by W. J. Priestley.¶ He shows that an increase in the figure obtained for reduction of area on tangential test bars occurs when the phosphorus and the sulphur content are reduced below 0.020 per cent. If we agree that reduction of area is a rough index of toughness and that the usual conception of shock strength is of

* Extract from "The Blast Furnace and Steel Plant."

† F. C. Langenberg, "Impact Tests on Cast Steel," Proc. A. S. T. M., 1921, page 810.

‡ "Heat Treatment of Steel Castings," Amer. Inst. Min. and Met. Engrs., Vol LXII., page 353.

¶ "Sulphur and Oxide in Steel," American Inst. Min. and Met. Engrs., February, 1922. "Iron Age," December 29, 1921, page 1658.

a property which combines toughness with good elastic limit we conclude that an improvement in shock strength is not achieved by a reduction of the phosphorus and sulphur content from 0.060 to 0.025 per cent.

It is gratifying to note that recent U.S. Army specifications for caterpillar tractor links or shoes permit sulphur to 0.07 per cent. and specify a heat treatment consisting of a straight anneal followed by a water quench and tempering. The tensile properties specified could readily be obtained with a simple annealing treatment indicating that the object of the heat treatment was to improve other than tensile properties.

Occasionally it is intimated that published articles and researches dealing with the question of phosphorus and sulphur are not written entirely in good faith as technical articles, but are perhaps inspired by commercial considerations. It is certainly quite clear that any producer of steel who resorted to propaganda to market an inferior article which would not function properly would be pursuing a very short-sighted policy indeed. It is equally clear, on the other hand, that any user of steel who unnecessarily insists, through ignorance or prejudice, on a costly and relatively less common product is pursuing an uneconomic policy both personally and industrially.

Physical Properties.

One of the frequently proposed revisions in physical property specifications is to require a reasonably accurate determination of the elastic limit, and to make this property, together with the usual ductility requirements, the basis for acceptance or rejection, the ultimate strength to be reported only as an item of information.

At first thought, this plan sounds very good. It is argued that the elastic limit is the property in which we are most interested. It is the property that has been used as the basis for design and it determines the point of failure in service more often than does the ultimate tensile strength. This is all true, but there are difficulties in the way of adopting this suggestion. One difficulty is that of definition, and another that of method. When we come to the question of an exact definition of the proportional elastic limit or proportional limit (which is the property commonly determined in actual testing and which closely corresponds to the elastic limit based on permanent set) and a method of determining it in practice, we find we have nothing hard and fast for a standard. Authorities on the testing of material state that the greater the refinement of measurement and the greater the delicacy of instruments used in determining the proportional elastic limit the lower the value obtained for this property.

Granted this situation is not peculiar to steel castings, but applies to other materials similarly tested. However, most of these materials, when subjected to the standard tensile test, show an almost constant stress-strain (load-stretch) ratio within the elastic range and a definite break from a straight line in the stress-strain curve which for practical purposes it is satisfactory to take as the proportional elastic limit. Actually the value obtained here is higher than that obtained in tests of greater precision and more nearly represents the yield point, which is defined as the stress at which there is a marked increase in rate of stretch with no increase of load.

Steel castings, on the contrary, do not show a constant cross-strain ratio. The amount of stretch under uniform increases of load is very irregular and the stress-strain curve is far from a straight line from its very beginning at the point of initial load. And so there is, of course, no one point where the proportionality of stress to strain shows a marked change, i.e., no true proportional elastic limit.*

Hence, for steel castings it is not feasible to specify the elastic limit and to require its determination by the usual stress-strain curve method. The alternative is to specify the yield point and to require a more accurate determination of it than is secured when the beam of the testing machine is used as an indicator. One satisfactory method of securing greater accuracy is to use an extensometer to detect the point of greatly increased rate of stretch. Another is the method of striking an arc on the chalked or smoked surface of the specimen and watching for the first visible widening of this arc. Both of these methods are quite workable and give a close indication of the actual yield point.

The usual determination of the proportional elastic limit, as has been noted, also actually gives a close measurement of the yield point, so there is no difference in the physical property measured and little difference in the value obtained under the two different requirements (where applicable). But while there is no difference in final results there is a difference in the properties originally specified and in the method of test contemplated in the specifications. It is highly desirable that both manufacturer and purchaser realise just what properties and characteristics of the steel it is the intention to establish under test and just what the properties are, which are actually determined in the prosecution of the test.

The fact that an elastic limit specification is not readily applicable to steel castings has been taken account of in some recently proposed revisions, which specify a minimum yield point instead of a minimum elastic limit, when the tensile strength specification is omitted.

Ductility Specifications.

The new manner of specifying the ductility requirements, i.e., in terms of the tensile strength or of the elastic limit or yield point is coming into more general use. The tensile strength is the more satisfactory to use for steel castings because it can be more exactly determined and because it shows a more uniform relation to the other properties. The new specifications state that the per cent. of elongation and the per cent. of reduction shall be equal to certain constants divided by the tensile strength, with a fixed per cent. of elongation and a fixed per cent. of reduction required as a minimum for each type of steel. The intention is, seemingly, to take into account the inverse relation which exists between the tensile strength and hardness of steel on the one hand and its ductility on the other hand, and the change from the former method of specifying a definite percentage of elongation and a reduction for each class of steel regardless of strength, is very logical. But when we come to examine the percentages required as a fixed minimum we find, in some specifications, that they are set so high as to correspond to the ductility of the softest steel in each class.

The sliding scale set up by the formula thus becomes inoperative over almost its entire range, because the value obtained by its use is always less than the fixed minimum. In a few cases where the tensile strength is unusually low relative to the yield point, which is up to the requirement, the scale might operate. The result would be, of course, a higher ductility requirement for the steel in question than the fixed minimum.

The net result, then, is to raise the ductility requirements. This would not be objectionable in itself if it were the end sought and were thought necessary. But after recognising the fact that for two steels of the same general class the one with the higher tensile strength and hardness will be less ductile than the one with the lower tensile strength and hardness, and this with no sacrifice of quality, it is illogical to turn about and say that the stronger steel must nevertheless show the ductility expected of the one of lower strength.

New Methods of Test.

Of late much more attention is being given to the strength of materials under repeated and reversed stresses and to methods of determining this property of resistance to fatigue.

Some very interesting data have been published covering the fatigue strength of ferrous metals in the rolled condition.* While cast steel probably has different fatigue properties from rolled steel, it is likely that some of the general facts established regarding the relation of fatigue strength

* Lawford H. Fry, "Tensile Properties of Steel Castings," Proc. A. S. T. M., June, 1922.

* H. F. Moore and J. B. Kommers, "An Investigation of the Fatigue of Metals," Bulletin 124, Engr. Experiment Station, University of Illinois.

to other properties will prove true for cast material also.

It was found that the ultimate tensile strength bears a closer relation to the fatigue strength (endurance limit) than does the elastic limit; that neither the ultimate tensile strength nor the elastic limit have a sufficiently close relation to the endurance limit to justify their use as an index of the latter; that of the tests more commonly used, the Brinell hardness test bears the closest relation to the endurance limit and gives the most promise of serving as an index of it.

The fact that the tensile strength shows a distinct relation to the endurance limit and that the elastic limit does not, may serve to modify the present estimation of the relative importance of these two properties. With regard to cast steel, this information is particularly pertinent because, as we have seen, cast steel has no true elastic limit, while its ultimate strength is a very definite property.

Brinell Testing.

The use of the Brinell hardness test is steadily increasing in metallurgical testing because of its ease of execution and dependability and the significance of its results, especially when the action of certain material or heat-treated part, under the Brinell test, has been previously studied. For these reasons, in cases where the material is subject to 100 per cent. test and inspection, the Brinell test is frequently specified by giving the limits of hardness desired. Now that some indication of the fatigue properties of the metal is also obtained by this test it will undoubtedly be employed to a still greater extent.

Brinell testing of steel castings has been done to a limited extent, largely for specific information as to hardness. The difficulty of applying the test to large pieces is an objection not easily overcome. It may be that the portable Brinell could be utilised for this purpose, though so far as the writer is aware this adaptation of the Brinell test is not nearly so well standardised as is the regular method.

Another serious objection would be the influence of minor surface defects or non-uniformity on the Brinell tests. On the other hand, we have the present method of judging the annealing of castings of various sections, by the visual examination of the fracture of an annealing lug with a section of ½ in., which it is readily admitted is a far from ideal method. In most cases where annealing lugs are used the inspection by means of their fracture is a 100 per cent. operation and the Brinell test could be applied with no greater consumption of time.

With the larger use of heat-treated castings which is surely coming, the Brinell test will undoubtedly be quite commonly specified.

Alpax—A New Aluminium Alloy.*

By M. de Fleury.

[Abstract.]

Known under the name of "Alpax" in France and the States, and by the name of "Silumin" in Germany, a new aluminium alloy has opened up many novel applications which have been set forth in the technical Press of the world. In all probability the extension of its utilisation will be extremely wide, for the new product fills a real need.

Basically it is a light foundry alloy, possessing high strength, and is not fragile, thus filling a need which is at present felt in the metallurgy of light alloys.

Duralumin possesses properties which are remarkable in many aspects, but only in the rolled or forged state, after having been quenched and tempered. In other words, as cast iron is to mild steel so is this new metal to duralumin, because alpax possesses excellent qualities in the cast state.

The composition of the alloy does not present from the theoretical point of view any novel characteristics. It is simply an alloy of 13 per cent. silicon and 87 per cent. aluminium. It is the eutectic point of the aluminium-silicon binary system. As is well known, a 13 per cent. silicon-aluminium alloy prepared in the ordinary way is fragile, of large grain, and is inferior to most alloys. However, a special treatment in the crucible gives it special qualities. This treatment was discovered by Dr. Pacz, the inventor of alpax, and has been set out in a series of patents which have been bought for France and America by the Compagnie des Produits Chimiques et Electro-Metallurgiques d'Alais, Froges et Camargue, and the Société d'Electro-Chimie et d'Electro-Métallurgie, and in Germany by the Metallurgische Gesellschaft, of Frankfort.

The treatment apparently consists of a physical and chemical refining, by means of alkaline salts.

Unfortunately, the theory of Dr. Pacz's reaction is not clear. It does, however, give an extremely light metal, which is fibrous, not fragile, and distinctly elastic.

The new metal presents the following characteristics:—

(1) It possesses a specific gravity of 2.64, which is 10 per cent. less than most ordinary aluminium foundry alloys. It has one-third the density of steel.

(2) Its resistance to atmospheric disintegration is at least equal to that of pure aluminium; that is to say, it is distinctly superior to normal aluminium foundry alloys.

(3) It produces perfectly sound castings, which allows of the manufacture of water-cooled monobloc cylinders with the greatest ease.

(4) Its contraction is not greater than that of cast iron, and is distinctly less than ordinary aluminium alloys.

(5) It is not fragile during its solidification period. This property, considered with the ones mentioned above, permits of the manufacture of the most difficult and complicated castings without any appreciable loss through wasters.

(6) The guaranteed tensile strength is 12 tons per sq. in. minimum, with an elongation of not less than 5 per cent., with the supplementary condition that the tensile strength, expressed in kilos. per sq. in., plus the elongation shall be greater than 25. These are mechanical results which are absolutely novel, and constitute a revolution in the use of light foundry metals.

(7) The breaking point of alpax at high temperatures (300 deg. C.) is greater than other aluminium foundry alloys.

(8) Finally, attention should be drawn to the use of alpax for castings subject to wearing.

Its application in the future, say within three or four years, in the motor-car industry should be trebled, providing the same number of cars are manufactured. It is possible to visualise motor-cars which will be comfortable, extremely light, speedy, and running with a lower petrol consumption than modern makes.

The immediate application of alpax includes the following: wheels, brakes, monobloc cylinders, pistons, connecting rods, and carriage work.

In order to realise the large margin of possible lightening, it may be stated that the simple substitution of the castings utilised in a cycle-car weighing 770 lbs. would allow the weight to be lowered by 132 lbs. without damaging the solidity nor the upkeep of permanent ways. A motor omnibus can be lightened by 550 lbs.

For ship construction alpax could be used for large Diesel engines. It is obviously particularly interesting for submarines and aviation.

Briefly, alpax can substitute steel castings where lightness is an essential. In railway construction in Germany alpax has already been used as a substitute for bronze in the manufacture of axle boxes, but this question is associated with the importation of copper.

The question has been dealt with in a more detailed form in a Paper which he read before the Société d'Encouragement, and published in their Bulletin No. 7, and also an article published in the May, 1922, issue of Revue de Métallurgie.

* A Paper presented before the Association Technique de Fonderie—the Nancy Conference.

BLAST VOLUME.—In this article, which appeared in our issue of August 31, two errata crept in. In col. 1, line 31, "add should read "all," and in col. 2, line 31, the square root sign has been omitted over "head of water in inches."

Making Electric Steel Castings.

By L. T. W.

The electric furnace is very suitable for the manufacture of steel castings, especially those of light and intricate nature, owing to the fact that it involves no temperature difficulties. The cost of production, if the furnace is worked continuously and cheap power is available, is fairly low. Cheap raw material can be used, consisting of rivet heads, punchings, turnings, etc., which can be refined and made into first-grade steel. The purity of the steel is unquestionable and the composition required is easily obtained, but whether low-phosphorus and an intensive deoxidation acts against fluidity is sometimes disputed.

Physical Properties.

Another important feature is that good mild steel can be made which, unannealed, will give mechanical tests to meet the demands of "British Standard Specifications" for ordinary castings, and castings made from such steel, if not intricate, may safely be despatched without annealing; but all intricate work and castings, to stand severe pressure, should be subject to heat-treatment, to remove all strains and casting structures.

The furnace should be run by a skilled and intelligent operator, for much depends upon the condition of the slags and the temperature, especially during the refining period; the writer prefers the services of one having a good knowledge of the chemistry of the process.

A Typical Heat.

Below will be found a description of a typical heat of mild steel, made in either a 2-ton "Electro Metals" or "Greaves-Etchell" furnace, working with two electrodes on 3-phase current at 85 volts, with an average of 3,500 ampères on each electrod phase.

The working of an electric furnace differs considerably from all other processes, the refining being accomplished both by oxidising and reducing conditions. The operations are divided into two complete parts, first, the reduction of the C., Si., Mn., and P. to 0.08, 0.03, 0.06 and 0.007 per cent., or thereabouts, respectively. Secondly, the reduction of the S. to 0.01 to 0.02 per cent., and also oxides left in the bath from the previous operation.

As in basic open-hearth practice, it is necessary, in order to remove the phosphorus from the charge, to reduce the carbon to the low percentage indicated.

Assuming the furnace to be hot from the previous cast, it is fettled as is found necessary. Obviously the slag line requires most attention; this is repaired with burnt dolomite, crushed, in the author's practice, to pass through a ½-in. or ¾-in. sieve, but some overloaded furnaces use the dolomite retrieved from banking up to increase the capacity. If the hearth is low, lime may now be charged on to the furnace bottom, followed by a little iron-ore, but, if high, it is advisable to mix with the charge, always being careful not to insulate the charge or hearth. Then a good layer of turnings or punchings are added, and, if runners, feeding heads, or "rejects," form part of the charge, these may be thrown in next, followed by another substantial layer of punchings. It is advisable to make the charge as dense as possible, as this will assist the current to pass directly through to the neutral return incorporated in the furnace hearth. Should the material used for charging be coated with rust, less need be added as sufficient oxide will be present for the oxidation of the charge.

The charging being complete, the current is switched on, and the electrode gear is operated by hand until a steady load is obtained; then the automatic switches may be brought into use. During the melting period more lime, and sometimes fluorspar and silica sand, are added to form a slag. This slag is maintained very fluid, and contains an excess of oxide of iron, which oxidises the carbon in the charge to form carbon monoxide; this, rising through the slag, gives the appearance of boiling. At the same time the silicon, manganese and phosphorus are also oxidised.

By taking a small spoon-sample of the molten metal, and examining it for either fracture, spark or bending, the operator is usually able to give a fair estimation of the carbon of the bath, which, if too high, more iron-ore should be added and time allowed for the reaction.

When the charge is well-oxidised and sufficiently hot, the oxidising slag is then removed. The furnace is tilted, and a part of the slag runs off; the electrodes are then raised well above the metal and the remainder drawn off with rakes (preferably wooden ones), so that the surface of the metal is practically clean. The furnace is then returned to its normal position, and the bath, recarburised to the desired degree with powdered anthracite, gives very consistent results; its action is rapid, and it gives from 50 to 60 per cent. efficiency. The anthracite, if too large, will not quickly disseminate, and, if too small, will agglomerate.

Reducing Period.

Either before or after recarburising, ferro-silicon is added, in lump form, in the proportion of about 10 to 12 lbs. of 50 per cent. ferro-silicon per ton of steel in the furnace (0.20 per cent. Si.); a new slag is then made up, consisting of lime, sand and fluorspar, and the current switched on.

As soon as the metal is sufficiently hot a sample is taken for carbon analysis, and meanwhile the process of refining proceeds.

Since the phosphorus has been practically removed, and since there remains in the steel the bulk of the sulphur and a large percentage of iron oxide, arising from the pre-slagging conditions, conditions must be instituted for their removal. The deoxidation of the metal is effected chiefly by the inter-reaction of ferro-silicon, generated calcium carbide, and the ferrous oxide. Whilst not theoretically correct, one can imagine that, whilst the bath is as still as a mill-pond, the sulphides of iron or manganese, having a lower specific gravity than liquid steel, rise to the top and are absorbed by the high-lime slag.

Sulphur is found by some to be difficult of removal from a low carbon bath, for the reason that it is difficult to kill, and sulphur will not leave a wild bath. It appears that there is only a small temperature range in which it is possible to kill low carbon steel. Thus, it is often necessary to lower the temperature to effect the killing. By this means the author obtains consistent results, which show that, with the carbon content as low as 0.20 per cent., the sulphur and phosphorus can be reduced to 0.01 or 0.02 per cent. in practically every case. Such practice is necessary in making stainless steel and iron and other alloy steels.

When treating the slag with powdered anthracite caution should always be used, for, if an excess is added, a dark grey slag, loaded too heavily with calcium carbide, will be obtained, resulting in a high carbon percentage.

From time to time small samples of steel are taken from the bath to ascertain the condition of the metal; the first one or two may appear "wild." If this is so, lump ferro-silicon should be added, in the proportion of about 2 lbs. per ton of steel, after each sample, until one is obtained which solidifies without rising, time having been allowed after each addition for the reaction. The temperature should also be adjusted until dead. Once dead, it can usually be raised without destroying the equilibrium temperature, and a good frothy slag maintained. Thirty to thirty-five minutes should be ample time for refining, and the final additions may then be made.

If the result of the analysis shows the carbon to be low, Spiegel and/or ferro-manganese is added to give the required percentage, and also to raise the manganese to the desired degree; then in a few minutes the steel is ready for pouring.

In some practice, though not altogether too desirable, ferro-titanium or aluminium is used as a final deoxidiser for the steel. If the latter is used, it may be added to the metal in the ladle, but if the former is used, the writer favours adding this to the steel in the furnace, just before pouring, as, owing to the higher melting point of this alloy, the reaction is assisted, being more rapid and complete than when adding to the steel in the ladle. Cases of hard spots have been traced to poor incorporation of ferro-titanium. A good mild steel

of the following composition, poured at proper temperature, will be found to give good results:—C., 0.20 to 0.25; Si., 0.20 to 0.25; Mn., 0.55 to 0.60; and P. and S., 0.02 per cent. maximum.

Unannealed steel of such a composition will give the following mechanical tests:—Maximum stress, 28 to 32 tons per sq. in.; angle of bend, 60 to 90 deg.; elongation, 15 to 20 per cent.

Ordinary or unimportant casting made from such steel might safely be dispatched without annealing, if desired, but work of an intricate nature should always be subject to heat treatment; for very intricate work and for thin pipes and valves, which have to be subjected to severe pressure, the writer recommends a higher carbon steel, which should always be annealed. The following forms a good composition for general work:—

C., 0.25 to 0.30; Si., 0.20 to 0.25; Mn., 0.55 to 0.60; and S. and P., 0.02 per cent. maximum.

Behaviour of Refractories on Heating.

In a Paper on "The Behaviour of Fireclays, Bauxites, etc., on Heating," presented to the Ceramic Society at Birmingham, MESSRS. H. S. HOULDSWORTH, M.Sc., and J. W. COBB, B.Sc., F.I.C., remark that the changes which occur in clays and similar substances on heating are very difficult, and indeed impossible, to follow by purely chemical methods; they have followed others in attempting to derive as much information as possible by a study of physical changes with which chemical changes may be associated.

The methods adopted have consisted essentially in taking the time-temperature curve of a thermocouple embedded in the specimen and comparing it with the curve given by a second couple placed in some standard reference substance heated alongside it. If at some temperature the former heating curve lags behind the latter, a change involving an absorption of heat is taking place in the specimen, but if at some point the rate of heating of the specimen is greater than that of the standard substance an exothermic reaction is occurring in the test-piece. The authors have prepared a large number of tables and curves, but they do not at the present stage attempt a complete explanation of the results obtained, which awaits the further evidence they hope to be forthcoming from other methods of examination which they are applying. The following points emerge, however:—(*a*) Kaolin and all the clays and shales examined show distinct heat absorption at a temperature of 500-530 deg. C. and heat evolution at a higher temperature. (*b*) This heat evolution occurs at a temperature of 1,060-1,130 deg. C. with pure alumina made by calcining aluminium nitrate at 700 deg. C., but at a temperature lower to an extent of about 100 deg. C. with the bauxites and clays, presumably on account of the impurities associated with the alumina in combination or some form of solution effective for the purpose. (*c*) Most of the materials show heat absorptions at temperatures below 500 deg. C. presumably due to the loss of water from colloid substances. (*d*) The phenomena observed with the clays are not primarily dependent on the presence of silica. They are noticeable with alumina and with a red bauxite practically free from silica. (*e*) For some reason, although alumina calcined at 700 deg. C. and the bauxites and clays show marked heat evolution at about 1,000 deg. C. as noted above, precipitated alumina gave no sign of it. It may be that the change responsible for the heat evolution had occurred with the precipitated alumina before it was heated in the apparatus, but that with aluminium nitrate or silicate the presence of the other material associated with the alumina deferred the change.

IN CONSEQUENCE of the continued trade depression, together with the recent rise in the price of coke, Alfred Hickman, Limited, Springvale Works, Bilston, near Wolverhampton, are compelled to curtail their production of pig-iron. They have, therefore, decided within the next fortnight to blow out one of their blast furnaces, either at Spring Vale or at the works of their allied company, Lloyds Ironstone Company, Corby.

Malleabilisation of White Iron.*

By E. RONCERAY.

Note on a communiqué issued by E. White and H. E. Gladhill of the University of Michigan.

This Paper is a discussion of researches which have been made in order to determine the relationship of time and temperature in the malleabilisation of white iron. These researches have for their object the determination of the minimum time in which the metal of any definite composition should be held at a certain temperature, together with the cooling speed necessary to bring about equilibrium.

Composition variations change the necessary time of these two periods, despite the fact that in current practice a safety factor so large must be taken that the effect of composition under normal conditions is not important.

The object of these researches is due to the fact that it has been thought that electricity could be used as a heating medium which would allow of very exact control of the operations, and it was imagined that it would be possible to reduce the time to such an extent that the cost of electricity as a heating medium would compare favourably with other methods.

Researches were made with the object of determining the minimum time necessary to obtain a good-quality product under varying conditions of composition and temperature. They have been able, in the laboratory, to reduce the normal heating time, which is 200 hours, to 34 hours. In practice this time would certainly not be sufficient because of the effect of quantity and size, but taking the double or treble, the time would still be very far from the usual 200 hours.

It has been ascertained:—

(1) That rapid heating produces graphite particles which are larger and more irregular than those produced by slow heating. This factor, however, is of small importance.

(2) That the duration of the heating period is determined by the temperature and composition of the metal. This period varies from a few hours at 982 deg. for several hundred hours at 760 deg. It is strongly influenced by small changes in the silicon content.

The carbon combined content at equilibrium conditions varies from 1.20 to 1.25 per cent. at 982 deg. C. to 0.48 per cent. at 760 deg. C. It is only slightly influenced by the silicon content.

3. That the cooling period is principally determined by the silicon content. The higher the silicon content the quicker the cooling.

With cast iron containing 0.82 per cent. silicon, the maximum speed of cooling compatible with the maintenance of equilibrium conditions varies from 14 to 20 deg. per hour (926-870 deg.) to 3, 4, or 5 (760-704 deg.). With an iron containing 0.90 per cent. of silicon the cooling speed of 13 to 15 deg. C. (815-760 deg.) can be used.

It is necessary to remember that these results relate to American malleable iron containing very little sulphur and of which the carbon is transformed into graphite and not eliminated as is customary in Europe. This paper is extremely interesting for European foundrymen, who are now studying with great interest the processes which can teach them to manufacture equally well American malleable iron of which the tensile strength and elongation are distinctly superior to European products, so much so that thicknesses much greater than is usual in Europe can be easily produced.

* A paper read before the Association Technique de Fonderie—Nancy Meeting.

Teeming Drums.

We notice in the foreign foundry Press that ladles are in some places giving way to drums. The drum is mounted on trunnions and geared to tip in either direction. A rectangular opening is cut from the centre of the barrel so as to form two lips. We presume this form has been designed in order to reduce the surface area and so minimise the radiation losses. We can imagine that this type of ladle would work excellently as a receiver.

Institution of British Foundrymen.

General Meeting at Manchester.

A special general meeting of the members of the Institution was held on October 7 at the Manchester School of Technology. Mr. Oliver Stubbs presided, and, in opening the proceedings, said the President, Mr. H. L. Reason, much regretted that he could not be present. He had asked that his place on this occasion should be occupied by Mr. Stubbs, as the immediate past-President.

Apologies for Absence.

The secretary, Mr. Hollinworth, read letters of apology received from Mr W. Lambert (Deptford), Mr. R. Buchanan (Birmingham), Mr. H. H. Moore (Loughborough), Mr. H. A. J. Rang (Newcastle), Professor T. Turner (Birmingham), Mr. E. H. Broughall (Coventry), Mr. J. Ellis (London), Mr. H. Bunting (Derby), Mr. F. W. Finch (Gloucester). There was also a telegram from Mr. M. Riddell (Glasgow).

New Rules Approved.

The Chairman said the meeting was called primarily for the purpose of passing the revised rules, necessitated by the Royal Charter granted to the Institution by the Privy Council. They had been drafted by a sub-committee presided over by Mr. Wesley Lambert, the new President of the London branch; they were afterwards submitted to the General Council, and then to Messrs. Sparks, Whitehouse, Russell & Company, the solicitors who drew up the Royal Charter. These gentlemen expressed the opinion that, although they did not exactly tally with the provisions of the Charter, they were near enough to meet the requirements of the Privy Council, and there was no necessity to make any alteration. Any changes required could be made by the Privy Council. The printed draft was now in the hands of the members. There was one omission. In rule 32, section 11, there should be a clause stating that an association was entitled to receive copies of such publications on payment of any prescribed fee, which shall be approximately the net cost to the Institution. That clause was in the old rules, but unfortunately had been omitted, and should be put in. The Branch Council rules did not come into this matter; they were not affected by the Royal Charter. He moved that the rules as presented, with the amendment he had indicated, be approved.

Mr. Carey Hill seconded the resolution, which was carried unanimously.

Mr. O. Stubbs Elected Vice-President.

Mr. Haigh (President of the Lancashire Branch) moved that Mr. Oliver Stubbs be asked to become senior Vice-President of the Institution. He explained that Mr. Jewson, who was elected senior Vice-President, and who, in the ordinary course, would have been President during the year 1923-24, had found that he could not retain the post. In those circumstances the Institution looked to Lancashire to get them out of a difficulty, and it would be met admirably by the selection of Mr. Stubbs.

Mr. Carey Hill seconded the resolution with great pleasure. It was the first step towards prevailing upon Mr. Stubbs to become the President next year, and after the amount of work which he did during his former tenure of that office, alhough it was only for nine months, it was very kind of him to come again to the assistance of the Institution.

The resolution was passed unanimously.

The Chairman, in reply, said this honour was not of his seeking. Business circumstances prevented Mr. Jewson from giving to the Institution the time needed for the work of Vice-President and President. For his own part he, along with many others, had given much time and hard work to the Institution, and great progress having been made during a very trying period, he was now particularly anxious there should be no going back. Therefore, if it was the wish of the members, he was willing to be President during the year 1923-24 on the understanding that he was not expected to carry through a tremendously big conference, like that recently held in Birmingham. In twelve months he travelled on foundry work over 30,000 miles. He would be very glad if he could do anything more to further the interests of the Institution.

Next Conference to be at Manchester.

Another matter for the members to consider was the question where the next conference should be held. The General Council had decided, very wisely, he thought, to take greater control over the conference arrangements than they had done in the past, and they would be glad to have an expression of opinion from the members as to where the next one should be held.

Mr. Simkiss stated that this matter had been considered by the Lancashire Branch Council, and there was a general feeling that it should be held in Manchester. He therefore moved that the General Council be recommended to hold the 1923 conference in Manchester.

Mr. Haigh seconded the resolution. He said the reasons which led to the selection of Blackpool instead of Manchester in 1921 no longer existed, and a thoroughly successful conference could be held in the city next year.

Mr. Simkiss added that Manchester was the best centre in the North of England for such a conference.

The resolution was passed unanimously.

Trade Talk.

The Blaenavon Company, Limited, have damped down one of their furnaces.

The Gorwall Company have removed to Faraday House, 8-10, Charing Cross Road, London, W.C.2.

The Teams Engine & Boiler Repairing Works, Teams, Gateshead-on-Tyne, have been seriously damaged by fire.

A japanning shop at the Diamond Foundry, Luton, of the Davis Gas Stove Company, Limited, was recently destroyed by fire.

At a meeting of the Metallurgical Club, in the Royal Technical College, Glasgow, Mr. P. M'Nair read a paper on "Stainless Iron."

Slight damage was done by a fire which recently broke out in a store at the works of F. W. Sibley & Company, Goldcroft, Yeovil.

In consequence of a mishap to a fly-wheel at the Lydney works of Richard Thomas & Company, Limited, extensive damage was done.

The Still Engine Company, Limited, announces that the remaining £50,000 debentures and 50,000 "A" shares are now offered to shareholders at par.

Hunter & Company, consulting and general engineers, have removed from District Bank Chambers, Harrogate, to Trafalgar House, Waterloo Place, London, S.W.1.

Bevan & Company (Iron and Brass Founders), Limited, Canal Side Wharf, Neath, have disposed of their business to Mr. W. E. Cope, of Glentworth, Sketty, Swansea.

The wages regulated by the Sliding Scale under the Midland Iron and Steel Wages Board will be reduced 5 per cent. from Monday, October 9, to Saturday, December 2.

Lithgows, Limited, of Port Glasgow, have secured contracts for the construction of four cargo steamers, making a total of eight orders for new vessels placed in the district within the last two weeks.

Mr. J. W. Hall, iron merchant, Lufton Street, Ashford, Kent, has sold his business, which will in future be carried on by his son, Mr. G. M. Hall, and Mr. H. R. Thorne as J. W. Hall & Company.

Wage increases running from 10 to 15 per cent., and affecting all classes of workers at the Sydney (N.S.) steel plant of the British Empire Steel Corporation, have recently been announced. Approximately 2,800 men are affected.

The Elgar Scholarship in Naval Architecture (1922) has been awarded by the Council of the Institution of Naval Architects to Mr. William Sprague, of H.M. Dockyard, Devonport, and the Earl of Durham prize to Mr. F. F. Crocombe, of H.M. Dockyard, Portsmouth.

At the next meeting of the Diesel Engine Users' Association, which will be held on Friday, October 27, at the Institution of Electrical Engineers, a paper on "The Care and Maintenance of Diesel Engines" will be discussed. The subject will be introduced by Mr. G. E. Windeler.

The Gas Department of the Borough of Port Talbot are inviting tenders for the supply and delivery of 2,500 yds. of 4-in., 2,500 yds. of 3-in., and 2,600 yds. of 6-in. cast-iron gas mains. They are to be to British standard specification and coated with Dr. Angus Smith's solution. Tenders must be in the hands of Mr. Moses Thomas, Town Clerk, Port Talbot, by October 16.

Company News.

Globe Tank & Foundry (Wolverhampton), Limited.—Capital £2,500.

J. B. White (Ratcliffe), Limited, Medland Street, Ratcliff, E.—Capital, £10,000 in £1 shares. Brassfounders.

J. & W. Wood, Limited, 62, Birmingham Street, Stourbridge, Worcs.—Capital £6,000 in £1 shares. Ironfounders.

Huntley Oil Engines, Limited, 4A, St. Andrew Street, Edinburgh.—Capital £5,000 in £1 shares. Directors: T. Huntley, J. M. Thomson, W. Hall, and J. Allan.

Clyde Crane & Engineering Company, Limited, 11, Merry Street, Motherwell.—Capital £30,000 in £1 shares. Directors: J. Jardine, D. Wilson, and J. Macgregor.

Bloomfield Engineering Company, Limited, 11, Avenue Road, Bloomfield Avenue, South Circular Road, Dublin.—Capital £1,000 in £1 shares. Directors: E. Hubbard, W. Byrne, and G. Byrne.

Coltness Iron Company, Limited.—Net profits £14,733; brought forward, £19,703; transferred from reserve to pay dividends on first and preference shares, £40,000; redemption fund, £25,000; carry forward, £21,738; ordinary dividend passed.

Bengal Iron Company, Limited.—Net profit, £125,492; brought forward, £22,178; written off in respect of exchange revaluation, £72,620; depreciation and colliery sinking fund, £25,833; debenture interest accrued, £1,104; preference share dividends, £37,500; net balance, £61,054; ordinary dividend, 2½ per cent., £39,350; carry forward, £21,703.

Burton Foundry Company, Limited.—Capital £50,000 in £1 shares (25,000 5 per cent. cumulative preference), to acquire the business carried on at Burton-on-Trent, Staffs., as "The Burton Foundry Company," and to adopt an agreement with F. S. Muirhead, P. D. Muirhead and A. Aitken. Directors: F. S. Muirhead (chairman), P. D. Muirhead, and A. Aitken.

United Steel Companies, Limited.—Liquidation of Workington Iron and Steel Branch and Harrington Coke Ovens completed, and assets appear in balance-sheet for first time; figure for "land, minerals, etc.," increased by £1,849,460 to £4,174,145, and goodwill increased by £563,456 to £816,825; losses for year of branches already liquidated, £156,675; loss by associated companies, £348,856; total loss, £505,531; stocks written down by £298,667; maintenance of idle plant, £312,321; surplus, apart from these items, £105,457; accumulated profits from branches liquidated embodied in profit and loss account with result that after charging branch losses for year and other charges and reserves there is net surplus £440,743.

Deaths.

Mr. J. P. Wirreck, manager to the Dudbridge Iron Works, Limited, Stroud, died on September 20, aged 41 years.

Mr. W. Pochin, chairman of the Standard Engineering Company, Limited, Leicester, died recently in his 81st year.

Mr. J. Keeling, for many years works manager to C. Akrill & Company, ironfounders, West Bromwich, died recently.

Mr. A. Lund, secretary of Riley Bros. (Boilermakers), Limited, Stockton-on-Tees, died on September 20, in his 54th year.

Mr. J. Whitehouse, one of the founders of the firm of J. & J. Whitehouse, Phœnix Foundry, Tipton, died on September 19, in his 88th year.

Mr. R. Hartley, formerly senior partner of R. Hartley & Sons, metal merchants, Long Brackland, Bury St. Edmunds, died on September 26, aged 74.

Mr. D. C. Watson, who was formerly connected with the South Durham Steel & Iron Company, Limited, and was on the Council of the North of England Iron & Steel Merchants' Association, died on September 20, in his 53rd year.

Monsieur Herman-Victor Hubert, honorary Inspector-General of Mines in Belgium, died on September 30, at the age of 73. The deceased gentleman was a member of the Iron and Steel Institute and the Institution of Mechanical Engineers.

MALLEABLE IRON PIPES.—Readers interested in the standard sizes for malleable iron pipe fittings can have the latest information by applying to the Secretary of the British Standards Association (Mr. C. le Maistre) at 28, Victoria Street, London, S.W., for Reports Nos. 143 and 154.

Book Review.

The Electro-Metallurgy of Steel. By C. C. Gow, A.R.S.M., B.Sc. Published by Messrs. Constable & Company, Limited, 10-12, Orange Street, London, W.C. Price 27s. 6d. net.

A study of the books devoted to the application of electricity to steel melting before the advent of Mr. Gow's book cannot fail to impress metallurgists who are *au fait* with the subject that it was high time a treatise was published which was something more than a write-up around manufacturers' catalogues. The book under review, though still not perfect, is by far the best contribution to the subject ever written in the English language. The writer is obviously one of great practical experience, whose knowledge has been gained by working all hours of the day and night. It presents in many places that clarity of thought and carefulness of observation which is so necessary in a metallurgist. Though his practical experience has mainly been derived from the Héroult type of furnace, he treats of conducting-hearth furnaces in as fair a manner as can be expected. Where he finds phenomena difficult of explanation he admits the fact and leaves theorisation to the reader. For instance, on pages 128 and 129 he says: "It is difficult to explain the discrepancy [the increase of phosphorus some six to eight points from slagging to casting], since the increase cannot possibly be due to a reduction of phosphorus from the unappreciable quantity of oxidising slag left behind after a careful skimming." We have in our possession a series of analyses of oxidising slags made in one of the most reliable laboratories in Europe, which show that such slags may contain over 30 per cent. of metallic iron and over 0.5 per cent. of phosphorus. Now, using these figures, this means that 92 lbs. of the oxidising slag would have to be left on the bath and banks of a three-ton furnace. Now such a furnace would, according to the author, require about 3 cwts. of lime, and produce probably 10 cwts. of slag. Therefore it would require that 8.3 per cent. of the slag be left on the bath and banks. We would further point out that these slags are amongst the heaviest known to ferrous metallurgy, and are often sold for the iron content. This being so, it is possible to visualise that they might be at slagging temperatures partially miscible in the bath. Then no amount of slagging can be of avail.

There are several other small points on which we are not in agreement with the author, but their recital might not carry the subject farther. We would, however, point out that his figures for calcium carbide in reducing slags are open to criticism, as the content of this compound is constantly diminishing owing to the action of atmospheric moisture. This is partially confirmed by the author's figures, wherein the lime content varies inversely with the calcium-carbide content.

There is one more point which should be cleared up in future editions, that is, the important question of sampling of high-speed steel. The method adopted in some works is to take the white-hot sample into a definitely dark room, and when no longer visible to the eye to quench in whale oil and then quickly burn off the oil in an ordinary laboratory muffle. It will then be found that it is possible to drill the sample comparatively easily.

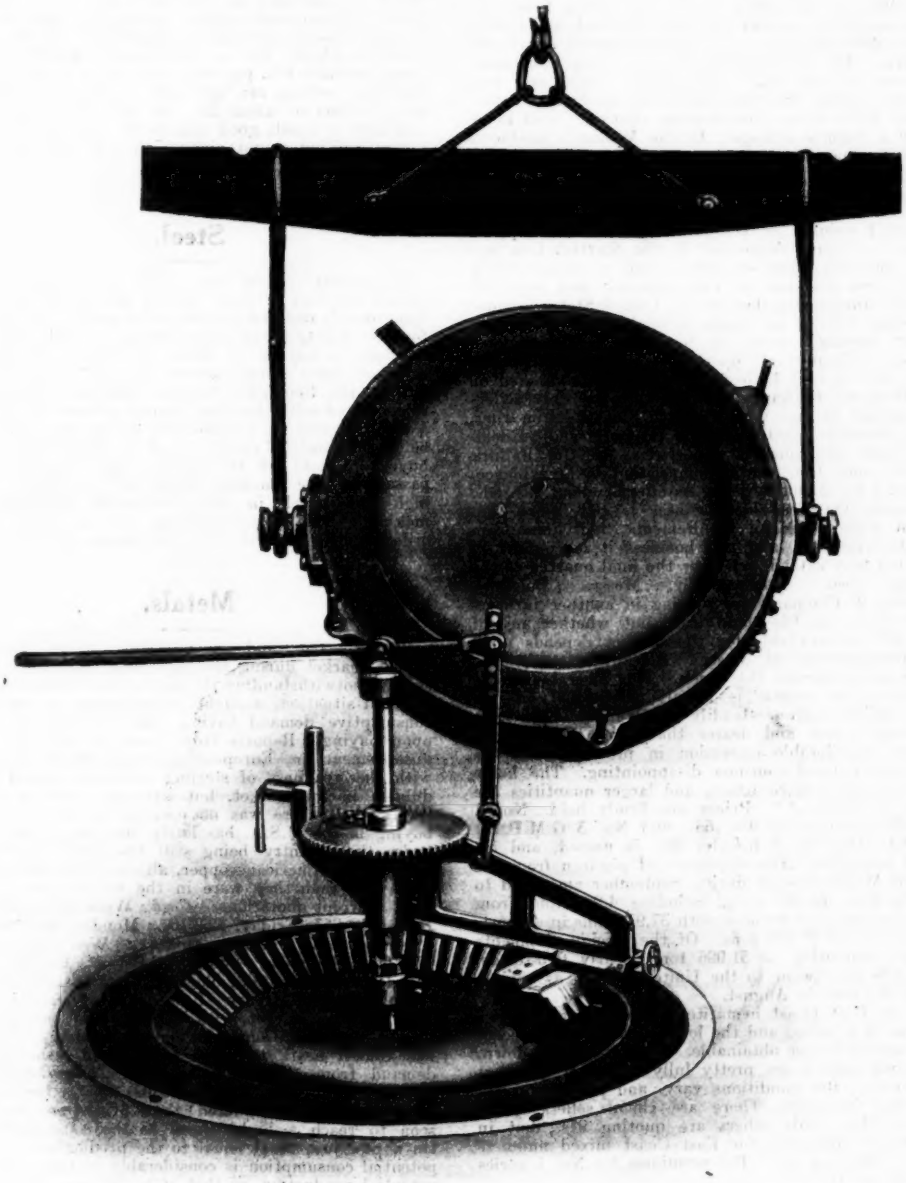
The book is divided into 15 chapters and illustrated with 132 figures. It should be in the hands of everybody connected with the electric-furnace industry, as it outlines the industry from the point of view of one intimately connected with it, and herein lies its true value.

British Brazing Company, Limited.—It has been resolved:—That the company be wound up. Mr. W. R. Graves, 17, Coleman Street, E.C., has been appointed liquidator.

British Electric Vehicles, Limited.—A petition was presented, September 25, by International Trade Exhibitions, Limited, Broad Street House, New Broad Street, E.C., promoters of exhibitions, for the winding up of the above company. Hearing, Royal Courts of Justice, Strand, October 17. Messrs. A. Benjamin and Cohen, 23, College Hill, E.C., solicitors.

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.



THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

JAMES EVANS & CO., BRITANNIA WORKS,

(MANCHESTER), LIMITED.

BLACKFRIARS, MANCHESTER.

IRON AND STEEL MARKETS.

Pig-iron.

A somewhat more cheerful note is observable in reports from the chief centres of the pig-iron industry, and although production is still on limited lines, furnace outputs at present are fully absorbed, and two or three additional plants are being restarted or already in blast. The recent heavy demand on export account, however, is now on a diminishing scale, and new business in that direction can hardly be further anticipated, while home consumption continues still much below a normal average. In the Midlands producers are still experiencing a slack time, consumers buying very sparingly, with only a sluggish demand, more especially for foundry qualities. Inquiries for forge iron also are disappointing, although in somewhat improved volume as compared with recent reports. General all-round depression in the Scottish iron and steel industries has, of course, had a corresponding effect upon markets for raw material, and with the steadily diminishing demand on United States account Clydeside makers are again dependent upon hand-to-mouth buying, which is barely sufficient to keep furnaces already in operation in full employment. There is now very little forward buying transacted on the Glasgow Exchange, and there were only sellers represented at last week's meeting of the iron ring, when offerings failed to elicit a response, and no dealings were consequently reported. In the Falkirk district some Continental competition is in evidence, imported No. 3 quality being on offer at about 92s. 6d., delivered. On Tees-side business is still more concerned with American requirements than home consumptive demand, and this business it is confidently expected may extend well over the final quarter of the current year. Consequently, Messrs. Bolckow, Vaughan & Company are putting in another furnace, and will be on Cleveland iron, but whether any of this will be available for the market depends upon the requirements of Messrs. Bolckow's steelworks, which are reopening this week. The general question of increase of output is largely conditional on fuel costs, which continue steadily to advance. With coke relatively scarce and dearer than ever the prospect of any considerable expansion in production in the near future must continue disappointing. The home trade is rather more active, and larger quantities are going to Scotland. Prices are firmly held, No. 1 and silicious quoting 97s. 6d., and No. 3 G.M.B. at 92s. 6d. For No. 4 foundry 90s. is named, and for No. 4 forge 85s. The shipments of pig-iron from the Port of Middlesbrough during September amounted to no less than 65,361 tons, including 4,928 tons from Skinningrove, as compared with 37,972 tons in August, an increase of 27,389 tons. Of the foreign shipments proper, amounting to 51,996 tons, nearly two-thirds, or 31,119 tons, went to the United States, as against only 9,862 tons in August.

In the East Coast hematite market a fairly active business is passing, and the lower quotations of recent dates are no longer obtainable. Stocks are well down, and some makers are pretty fully sold over the next few weeks. But conditions vary, and prices are still somewhat irregular. There are cheap sellers at as low as 89s., while others are quoting 91s., but in general the quotation for East Coast mixed numbers is about 90s. per ton. The premiums for No. 1 varies from 6d. to 1s.

Finished Iron.

Very little sign of improvement can be noted in the general outlook of the finished iron sections of the trade, buying, as previously reported, being confined to strictly immediate requirements, and orders, as a rule, on quite an unimportant scale. The quarterly meeting at Birmingham this week is hardly anticipated to disclose any change for the better in the conditions now prevailing, and as far as prices are concerned, makers are practically unanimous in asserting that until the costs of production and transport are materially reduced lower quotations are entirely out of the question. Foreign competition in such material as nut and bolt iron continues active, and to secure orders Black Country makers have to make concessions in prices which they can ill afford in existing circumstances. Crown bars are also unfavourably situated at the moment, makers now accepting slightly shaded quotations to obtain business. Makers of marked bars, though more steadily employed, have few future commitments booked, and would welcome some substantial orders to ensure mills working continuously over the remainder of the year. The output returns of the Midland Iron and Steel Wages Board for July and August are slightly more encouraging as compared with those of the two preceding months.

Scrap.

Conditions in the scrap metal trade can hardly be described as satisfactory, and with one or two exceptions the business passing in the various markets continues quiet, if not actually depressed. Accepting Middlesbrough as a representative market for iron and steel scrap, an outstanding feature has been the continued demand for heavy qualities of the latter material which for a satisfactory specification is freely realising 65s. per ton. Heavy steel turnings and cast-iron borings are also still in demand, and the price is firm at about 52s. 6d. per ton. Business in cast iron is quiet, good machinery qualities in handy pieces making round about 73s. 6d. per ton, with ordinary descriptions 70s.

Steel.

Movements in the steel industry continue without special features of fresh interest and are for the time being mostly concerned with semi-products, the demand for acid billets being rather better, with slightly more freedom in buying of basic qualities. There has, however, been some reaction in the crucible steel branch, the September returns showing unfavourably as compared with the more hopeful prospect in August. Various reasons are assigned for the set-back, the chief being the unsettled conditions of the Near East causing buyers to hold off the market, and also the quick passage of the Fordney Tariff Bill into law. The high-grade steels in which Sheffield specialise are making a little better showing, but the bulk of the orders coming to hand is for the cheaper qualities.

Metals.

Copper.—The tendency of values in the standard copper market during the past week has been fairly steady, notwithstanding the depressing influence of the political situation, a slight improvement in the home consumptive demand having had a stimulating effect upon buying. Reports from America state that the unsettlement in European political affairs combined with the weakness of sterling exchange caused some dulness in the market, but although quotations gave way slightly there was no pressure to sell. German buying in the U.S.A. has lately been on an improved scale, that country being still the best Continental customer of American copper, although her takings are much less than they were in the earlier part of this year. Current quotations:—*Cash*: Wednesday, £63 5s.; Thursday, £63; Friday, £62 10s.; Monday, £63 2s. 6d.; Tuesday, £63. *Three months*: Wednesday, £63 17s. 6d.; Thursday, £63 10s.; Friday, £63 2s. 6d.; Monday, £63 12s. 6d.; Tuesday, £63 12s. 6d.

Tin.—Messrs. Henry Bath and Son, Limited, report:—This market, with slight fluctuations, has improved steadily. Consistent buying by large interests has caused bears to cover freely, and although the demand from English consumers leaves room for improvement, America has at times been a free buyer. It is generally considered that prices are destined soon to reach a higher level as the consumption of tin is now just about equal to the production, and the potential consumption is considerably in excess of the potential production, so that if trade were allowed to go ahead without any outside interference from labour troubles and political disputes, only a higher price could keep the balance more or less level. The tin-plate works in America are doing a big business, and although the works in South Wales complain, they have nevertheless secured some very good orders lately. The East has continued to sell moderate quantities at full prices. Current quotations:—*Cash*: Wednesday, £163 5s.; Thursday, £163 10s.; Friday, £163 10s.; Monday, £163 17s. 6d.; Tuesday, £165 2s. 6d. *Three months*: Wednesday, £164 7s. 6d.; Thursday, £164 10s.; Friday, £164 12s. 6d.; Monday, £165 2s. 6d.; Tuesday, £166 5s.

Spelter.—The market for this metal records a consistent advance in values, the principal strength having been in the forward position. Buying on home account has shown some improvement, while the absorption of the metal in America is steadily growing. Current quotations:—*Ordinary*: Wednesday, £33; Thursday, £33; Friday, £33; Monday, £33 2s. 6d.; Tuesday, £33.

Lead.—Business in soft foreign pig has again been on an active scale, and the heavy arrivals have been readily absorbed. America is consuming large quantities, while the Continent is also buying more freely. Current quotations:—*Soft foreign (prompt)*: Wednesday, £25 7s. 6d.; Thursday, £25 7s. 6d.; Friday, £25 2s. 6d.; Monday, £25 5s.; Tuesday, £25 5s.

Telephone: 21, Penistone. Telegrams: "Durranns, Penistone."

ESTABLISHED 1863.

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Phoenix Works, Penistone NEAR SHEFFIELD.

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PLUMBAGO
CORE GUM
WHITE DUST
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Manufacturers of

FOUNDRY EQUIPMENTS.

Ladles, Cupolas, Fire Bricks, Ganister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

Write for illustrated catalogue on Blacking and Foundry Requisites, also for our latest Price List.

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

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GANISTER, CUPOLA BLOCKS, FIRE BRICKS, FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

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DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

WEEKLY PRICE CURRENT.

COPPER.

	£	s	d.
Standard cash ..	63	0	0
Three months ..	63	12	6
Electrolytic ..	71	0	0
Tough	65	10	0
Best selected ..	65	10	0
Sheets	96	0	0
India	84	0	0
Wire bars ..	70	17	6
Do. Nov. ..	70	17	6
Do. Dec. ..	70	17	6
Ingot bars ..	70	17	6
H.C. wire rods ..	76	0	0
Off. aver. cash, Sept.	63	3	4½
Do. 3 mths., Sept.	63	12	5½
Do. Settlement Sept.	63	2	11½
Do. Electro, Sept.	71	3	2½
Do. B.S., Sept. ..	67	0	0
Aver. spot price, copper, Sept. ..	63	2	7½
Do. Electro, Sept.	71	8	1

Solid drawn tubes .. 13½d.
Brazed tubes .. .. 13½d.
Wire .. .. .. 10½d.
Yellow metal rods .. 6½d.
Do. 4x4 Squares .. 8½d.
Do. 4x3 Sheets .. 9½d

BRASS.

Solid drawn tubes .. 11½d.
Brazed tubes 13½d
Rods, drawn .. .. 10½d.
Rods, extruded or rolled 6½d.
Sheets to 10 w.g. .. 10d.
Wire .. .. .. 9½d.
Rolled metal .. 9½d.

TIN.

Standard cash	165	2	6
Three Months	165	5	0
English	164	12	6
Bars	166	12	6
Chinese	164	2	6
Straits	165	12	6
Australian ..	165	10	0
Eastern	166	15	0
Banca	165	5	0
Off. aver., cash, Sept.	160	2	8½
Do. 3 mths. Sept.	160	0	7½
Do. Stlment Sept.	160	2	3½
Aver. spot, Sept.	160	1	3½

SPELTER.

Ordinary ..	33	0	0
Remelted ..	31	5	0
Hard	25	0	0
Electro 99.9 ..	36	10	0
English	33	2	6
India	24	10	0
Prime Western	33	0	0
Zinc dust ..	48	0	0
Zinc ashes ..	10	15	0
Off. aver., Sept.	31	8	8½
Aver., spot, Sept.	31	14	10½

LEAD.

Soft foreign ppt ..	25	7	6
English	26	10	0
Off. average, Sept.	23	16	3⅝
Average spot, Sept.	24	2	9

ZINC SHEETS.

Zinc sheets, English	38	0	0
Do. V.M. ex. whf.	38	10	0
Dutch	38	0	0
Rods	42	5	0
Boiler plates	36	0	0
Battery plates ..	36	10	0

ANTIMONY.

English regulus ..	27	0	0
Special brands ..	33	10	0
Chinese	25	10	0
Crude	17	0	0

QUICKSILVER.

Quicksilver 12 15 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
45/50% 11 10 0
75% 20 0 0

Ferro-vanadium—
35/40% 17/- lb. va.

Ferro-molybdenum—
70/75% 8/6 lb. mo.

Ferro-titanium—
23/25%, carbonless 1/1 lb.

Ferro-phosphorus, 20/23%, £27

Ferro-tungsten—
80/85%, carbon free 1/5 lb.

Tungsten metal powder—
98/99% .. .. 1 11 lb.

Ferro-chrome—
4/6% car. £23 0
6/8% car. .. £22 12 6
8/10% car. .. £22

Ferro-chrome—
Max. 2% car. .. £55
Max. 1% car. .. £68
Max. 0.70% car. .. £75
67/70%, carbonless 1/6½ lb.

Nickel—99%, cubes or pellets £140

Cobalt metal—98/99% 12/- lb.

Aluminium—98/99% £100

Metallic Chromium—
96/98% .. .. 4/9 lb.

Ferro-manganese (net)—
76/80%, loose .. £15
76/80%, packed .. £16
76/80%, export .. £14 10

Metallic manganese—
94/96%, carbonless 2/4 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten .. .. s. d. 2 6
Finished bars, 18% tungsten 3 0
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ½ in. 3d. lb,
Flats under 1 in. by ½ in. to ½ in. by ½ in., and all sizes over four times in width over thickness .. .. 3d. lb.
Bevels of approved sizes and sections .. 6d. lb.
If in coils .. .. 3d. lb.
Packing .. ..£3 ton.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces .. .. 3d.
Turnings and swarf .. 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.	£	s.	d
Heavy Steel	3	5	0	3	10	0
Bundled steel & shearings	2	16	6	3	7	6
Mixed iron & steel	2	15	0	3	2	6
Heavy cast iron ..	3	7	6	3	15	0
Good machinery for foundries	3	15	0	4	0	0
Cleveland—						
Heavy steel ..	3	5	0			
Steel turnings ..	2	12	6			
C st-iron borings	2	12	6			
Heavy forge ..	3	12	6			
Bushelled scrap ..	2	15	0			
Cast-iron scrap ..	3	10	0			
Lancashire—						
Cast iron scrap ..	3	17	6			
Heavy wrought ..	3	7	6			
Steel turnings ..	2	2	6			

London—	£	s.	d.
Copper (clean) ..	56	0	0
Brass (clean) ..	30	0	0
Lead (less usual draft)	20	0	0
Tea lead	19	0	0
Zinc	17	0	0
New aluminium cuttings ..	60	0	0
Brazier y copper ..	46	0	0
Gun metal ..	40	0	0
Hollow pewter ..	125	0	0
Shaped black pewter	80	0	0

Above are merchant's buying prices delivered yard.

PIG-IRON.

N. E. Coast—
Foundry No. 1 .. 97/6
Foundry No. 3 .. 92/6
Forge No. 4 .. .. 85/-
Mottled 80/-
Hematite No. 1 .. 90/9
Hematite M/Nos. .. 90/-

Midlands—
Staffs. common .. —
„ part-mine forge —
„ „ foundry —
„ Cold blast .. 240/-
„ basic .. .. —

Northants forge 70/- to 72/6
„ foundry No. 3 77/6 „ 80/-
„ basic 80/-

Derbyshire forge .. 75/-
„ foundry No. 3 82/6
„ basic .. 80/-

Scotland—
Foundry No. 1 .. 105/-
„ No. 3 .. 100/-
Hematite M/Nos. .. 107/6

Sheffield (d/d district)—
Derby forge 82/6
„ foundry No. 3 86/6
„ basic .. .. —
Linca. forge 86/6
„ foundry No. 3 86/6
„ basic 86/6
E.C. hematite .. 101/-
W.C. hematite .. 102/6
All d/d in the district.

Lancashire (d/d eq. Man.) —
Derby forge .. .. —
„ foundry No. 3 90/-
Northants foundry No. 3 .. .. —
Cleveland foundry No. 3 .. .. —
Staffs. foundry No. 3 —
Linca. forge .. .. —
„ foundry No. 3 —
Summerlee foundry .. 116/6
Glengarnock foundry 118/6
Gartsherrie foundry 118/6
Monkland foundry .. 116/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.
Bars (cr.)	£10 10 to 11	10	0
Angles	£10 15 to 11	15	0
Tees to 3 united ins.	£11 to £12		
Nut and bolt ..	9	15	0
Hoops	14	0	0
Marked bars (Staffs.) ..	13	10	0
Gas strip ..	11	0	0
Bolts and nuts, ½ in. × 4 in.	18	10	0
Steel—			
Ship plates	£9 to 9	10	0
Boiler plates ..	12	10	0
Chequer plates	10	5	0
Angles	£8 12 6 to 9	0	0
Tee	£9 12 6 to 10	0	0
Channels ..	8	10	0
Joists	9	0	0
Rounds & squares 3-in. to 5½in. ..	9	15	0
Rounds, under 3in. to ½in. ..	9	5	0
Flats, over 5in. wide and up ..	9	15	0
Flats 5in. to 1½in.	8	5	0
Rails, heavy ..	8	15	0
Fishplates ..	14	10	0
Hoops	11	10	0
Black sheets, 24 g.	12	0	0
Galv. cor. sheets, 24 g.	16	5	
Galv. fencing wire, 8 g. plain ..	16	0	0
Rivets, ½ in. dia	12	15	0
Billets, soft	7 0 0 to 7	2	6
Billets, hard ..	8	0	0
Sheet bars	6 17 6 to 7	7	6

PHOSPHOR BRONZE.

	Per lb basis
Strip	1 3
Sheet	1 3½
Wire	1 3½
Rods	1 2½
Tubes	1 6
Castings	1 1

Delivery 3 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.
Charles Clifford & Son Limited, Birmingham.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	11d. to 1/5
Rolled—	
To 9 in. wide	1/5 to 1/11
To 12 in. wide	1/5½ to 1/11½
To 15 in. wide	1/6 to 2/0
To 18 in. wide	1/6½ to 2/0½
To 21 in. wide	1/7½ to 2/1½
To 25 in. wide	1/8½ to 2/2½
Ingots for spoons and forks ..	11d. to 1/5
Ingots rolled to spoon size ..	1/2 to 1/8
Wire round—	
3/0 to 10. G. ..	1/8½ to 2/3½

with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	34.26
No. 2 foundry Valley ..	33.00
No. 2 foundry, Birm. ..	27.00
Basic	35.96
Bessemer	35.77
Malleable	35.96
Grey forge	34 27
Ferro-manganese 80 % delivered	75.00
Bess. rails, h'y, at mill	40.00
O.-h. rails, h'y, at mill	40.00
Bess. billets	40.00
O.-h. billets	40.00
O.-h. sheet bars ..	40.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.47
Steel bars	2.10
Tank plates	2.25
Beams, etc.	2.00
Skelp, grooved steel ..	2.00
Skelp, sheared steel ..	2.00
Steel hoops	2.75
Sheets, black, No. 28 ..	3.35
Sheets, galv., No. 28 ..	4.35
Sheets, blue an'l'd, 9&10	2.50
Wire nails	2.70
Plain wire	2.45
Barbed wire, galv. ..	3.35
Tinplate, 100-lb. box ..	$4.75

COKE (at ovens).

Welsh foundry .. 35/- to 37/6
„ furnace .. 26/- to 27/6
Durham & North. foundry 28/-
„ furnace .. 23/6
Other Districts, foundry 27/6
„ furnace 25/-

SWEDISH IRON.

Bars, hammered basis sizes Basis price £22 to £23

Rolled Ordinary— Assortment ..	£ 17	s. d. 10 0
Nail Rods— Square, round and flats ..	to 18	0 0

Keg Steel nom. £38 to £40
Faggot Steel nom. £30 to £32

Blooms—
Single welded .. £10 to £11

Billets—
Single and double welded £13 to £14

Pig-Iron—
Grey, white or mottled .. £7 to £7 10 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents here.

TUBES.

	Up to and incl. 6 in.	
Gas ..	55%	Tube prices are now free.
Water ..	50%	
Steam ..	45%	

TINPLATES.

I.C.Cokes,	20×14, box	18/9
,,	28×20, ,,	38/-
,,	20×10, ,,	27/9
,,	18¾×14, ,,	19/6
I.X.	,,	43 9
I.X.X.	,,	50,6
F.C.B.Y.	21×13½ ,,	36/6
C.V.B.G.	16¾×15, ,,	35/-
I.C.W.	20×14, ,,	16/7½
,,	28×20, ,,	33/-
,,	20×10, ,,	22/9
,,	18¾×14, ,,	17/1½
Terneplates,	28×20, ,,	35/-

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Oct. 4	63	5	0	dec.	5/-
,, 5	63	0	0	,,	5/-
,, 6	62	10	0	,,	10/-
,, 9	63	2	6	inc.	12/6
,, 10	63	0	0	dec.	2/6

Electrolytic Copper.

Oct. 4	71	5	0	dec.	5/-
,, 5	71	5	0	No change	
,, 6	71	5	0	,,	
,, 9	71	0	0	dec.	5/-
,, 10	71	0	0	No change	

Standard Tin (cash).

Oct. 4	163	5	0	dec.	30/-
,, 5	163	10	0	inc.	5/-
,, 6	163	10	0	No change	
,, 9	163	17	6	inc.	7/6
,, 10	165	2	6	,,	25/-

Tin (English ingots)

Oct. 4	163	0	0	dec.	30/-
,, 5	163	0	0	No change	
,, 6	163	0	0	,,	
,, 9	163	10	0	inc.	10/-
,, 10	164	12	6	,,	22/6

Zinc Sheets (English)

Oct. 4	38	0	0	No change	
,, 5	38	0	0	,,	
,, 6	38	0	0	,,	
,, 9	38	0	0	,,	
,, 10	38	0	0	,,	

Spelter (ordinary).

Oct. 4	33	0	0	inc.	5/-
,, 5	33	0	0	No change	
,, 6	33	0	0	,,	
,, 9	33	2	6	inc.	2/6
,, 10	33	0	0	dec.	2/6

Lead (English).

Oct. 4	26	5	0	No change	
,, 5	26	5	0	,,	
,, 6	26	5	0	,,	
,, 9	26	5	0	,,	
,, 10	26	10	0	inc.	5/-

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ARMITAGE WORKS Co., Ltd.
Manufacturers of
Highly Refractory Bricks and Blocks
FOR ALL PURPOSES.

SPECIALITIES:
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Ladle Bricks for Siemens Ladles.
Chequer Bricks, etc., for Siemens Furnaces.
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London: 10, Bush Lane, Cannon St., E.C.4.

Telephone:—
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5939 Central.

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To all Specifications.

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BEST H. C. COPPER & BRONZE WIRE a speciality.

Medals:—Sydney (Bronze) 1879, New Zealand (Gold) 1882, Liverpool (Silver) 1886, Adelaide (Gold) 1887, France-British Grand Prix (Highest Award) 1908.

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SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.
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COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM COLVIN & COMPANY,
ROYAL EXCHANGE, MIDDLESBROUGH.
93, HOPE STREET, GLASGOW.

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MOULDER REQUIRES STEADY AND PROGRESSIVE JOB. Accustomed to complete control. Motor and General Engineer and Jobbing. Personally operating Cupola and other Furnaces, making oil-sand jacket cores, and supplying castings to analysis. Iron, Aluminium and Bronze. Good Technical and Practical: Mathematics, Mechanics, Chemistry, Physics, Metallurgy, Iron and Steel Manager and Mechanical Drawing. Good knowledge of costs, and could assist in Drawing Office, Pattern Shop or any department of Foundry. I.B.F. and B.C.I.R.A. Man. — Apply: F. A., c/o Ignition Laboratory, 57, Union Street, Oldham, Lancs.

ADVERTISER desires Position, where experience and ability is required, as Foundry Foreman or Manager; 19 years' practical and technical training all branches iron and non-ferrous work; 9 years as Foreman and Manager. Experience on Motor, Engineering and Jobbing Work up to 20 tons. Expert on Cuplos, mix metals by analysis, knowledge of metallurgy; good organiser, tactful with labour. Guarantee consistent results. McLain and I.C.S. graduate.—Box 264, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOUNDRY MANAGER or Assistant, age 38, experienced Steam and Motor Cylinders, Pumps, etc., Quantity Production, desires Engagement. Patterns, Moulding Equipment, Mixing by Analysis, Cupola Practice, extensive Experience of Oil Sand Cores, Core Jigging, modern Core- and Mould-drying Stoves. Knowledge costing and estimating. A.M.I.Brit.F.—Replies, "M.," Hill View, Pollards Hill West, Norbury, London, S.W.16.

FOUNDRY FOREMAN (31) desires progressive and responsible situation; technical and practical experience in up-to-date methods of production; Green and Dry Sand, Plate and Machine, Pattern Plates, Core Making, personally operated Cupola, mix to analysis; good organiser.—Box 272, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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WANTED, FIRST-CLASS MACHINE CORE MAKER. State age, wages, experience of Machines, to Box 272, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

AGENCIES.

SOLE AGENTS required in all industrial districts in Great Britain, and also for Foreign and Colonial Countries, for an entirely new Foundry Product, which is now being used by some of the leading foundries with every satisfaction; time saving and efficiency in its use; splendid opportunity for live firms. State district.—Write Box 260, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

ACTIVE AGENT, established in Belgium, well up in Metallurgical Trade, in constant touch with Rolling Mills of South Belgium and Luxembourg, wishes to act as Buying Agent on commission for large English Builders or Exporters. Best references. —Write to A. K., Eclair-Publicite, Charleroi, Belgium.

MACHINERY.

NEW WELDING PLANT, with Acetylene Generator, six blowpipes, etc., ready for use, £17 5s.; complete new Cutting Plant, £15 10s. Lists free.—STANSELL'S ACETYLENE COMPANY, LIMITED, Exeter.

ONE 20-in. CENTRIFUGAL FOUNDRY SAND MIXER, capacity 1 to 2 tons per hour, fitted with latest improvements and equal to new.—Price and particulars on application to C. E. V. HALL, 26, Paradise Square, Sheffield.

WANTED, small Moulding Machine, hand or power, to handle boxes about 20 in. x 14 in. Jolt Ramming Machine, plain or with turnover table, to take boxes 3 ft. 6 in. square, 20 in. deep.—Box 262, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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FOUNDRY SAND MIXERS (three), never been used, for 1, 2 and 4 tons per hour; clearance prices.—Box 158, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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Two Cross Compound Horizontal Drop Valve Engines, 12½ in. and 20 in. cylinders, 26 in. stroke, by Robey and Company, Limited. Cross Compound Horizontal Engine, 11 in. and 19 in. cylinders, 26 in. stroke, by Marshall, Sons and Company, Limited. Vertical Compound Open Type Engine, 15 in. and 22 in. cylinders, 18 in. stroke, by Browett, Lindley and Company. Vertical Compound Open Type Engine, 12 in. and 19 in. cylinders, 12 in. stroke, by Tangyes, Limited. Nearly New Surface Condensing Plant, by F. Pearn and Company, 10 in. and 16 in. steam cylinders, 12 in. stroke, surface area of tubes about 1,200 ft. Worthington Steam-Driven Jet Condensing Plant, 7½ in. and 12 in. steam cylinders, pump bucket 16 in., 12 in. stroke, 7,000 lbs. condensed steam per hour. 8 ft. Vertical Boring and Turning Mill, by J. Hetherington and Company, to take 5 ft. underneath tool boxes, two swivel tool boxes. Planing Machine, to plane 14 ft. by 5 ft. by 4 ft., two tool boxes on cross slide, by J. Buckton and Company, Limited. Multiple Punching Machine, by Rushworth and Company, capacity 33 holes—17/32 in. diameter through plates 3/16 in. thick, 3 in. pitch. 12 in. stroke Shaping Machine, quick return motion, two tables, 21 in. by 13 in. by 13 in., by Jas. Archdale and Company, Limited.

Catalogue of Stock Machinery, 5-6,000 Lots.
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ALBION WORKS,
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OIL-ENGINE DRIVEN COMPRESSOR, by Blackstone, 300 lbs. pressure, 120 cubic ft. per minute, 45 h.p.; as new. 26½ kw. New Steam Generating Set, by Browett Lindley-Laurence Scott, 110 volts. 20-h.p. 220-volt Siemens Motor and Starting Panel; as new. Two nearly new Sand Mills, 32-in. pan.—HARRY H. GARDAM & COMPANY, LIMITED, Staines.

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ADVICE and Handbook Free.—KING'S PATENT AGENCY, LIMITED, Director, B. T. King, Reg. Patent Agent, 146a, Queen Victoria Street, E.C.4.

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PENCIL GANISTER, of high quality, and other grades for Sale.—Apply, R. E. ADAMSON, Ushaw Moor, County Durham.

PATTERNS of Every Description, Large or Small. Let us quote you for sound, accurate, well-finished Pattern, or a cheap rough job. We can give you quick delivery at keen prices. Fully-electrically-equipped works; over 30 years' practical experience.—WALTER TOTTY, Greenfoot Pattern Works, Old Town, Barnsley.

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30 in. ALLDAYS CUPOLA, with hood and lining bricks, drop bottom, very good condition, in stock here, **£55 on rail**; blower to suit, **£12** extra.

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MORGAN TILTING FURNACES, S. type, 600 lb. capacity, coke-fired, ex-Government (six in stock) .. each **£80**

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Belt-driven **SAND SIFTER** **£9**
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60 **STEEL COREPLATES,** 22 in. square .. .. each **6s.**
2 **PNEUMATIC HOISTS,** by TABOR, as new, 6 ft. travel „ **£9**
CLIMAX COREWIRE STRAIGHTENER, 1/16th in. to ¼ in. capacity **£16**
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ELECTRIC FURNACE, by HEROULT, 3½ ton, new.
2-ton "STOCK" CONVERTER PLANT, new.
200 pairs of MOULDING BOXES (send for list)
WOOD PATTERN SHOP OUTFIT, send for list, offered very cheap

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